

# BYD - H (1211 HK)

## Hidden giant in the cave

Prompted by government policy and technological innovation, China's NEV market is expected to enter into a rapid growth period with CAGR of 43% in 2020-25E. As the pioneer in the NEV field in China, BYD was ranked No.1 in NEPV/No.4 in NECV in 2019. We believe that the Company will maintain its excellent performance thanks to its technological advantages and brand recognition in the future. The Company is experiencing a re-rating process as supply chain open up activities help release value from power battery and IGBT. We believe the re-rating is yet to finish. We initiate BUY with SOTP-derived TP of HK\$100.00 per share.

- China NEV industry to usher rapid growth from 2021E.** We forecast that NEV sales volume will achieve 1.7mn units in 2021E, an increase of 66% YoY, supported by favorable policies such as the extension of subsidies/the implementation of the double credit policy. BYD, as the undoubted leader in China's NEV field, launched its blade battery early this year and will subsequently launch its DM4.0 platform in 4Q20E, supporting NEV sales growth. We expect its total vehicle sales (ICE and NEV) to increase by 34% YoY in 2021E. The corresponding revenue from the auto segment will achieve an increase of 47% YoY to RMB83.3bn in 2021E.
- Blade Battery: a potential game-changer.** BYD recently launched blade battery and the first model (Han) equipped with blade batteries. While ensuring safety, the blade battery extends the mile range, broadening the application scenarios of traditional LFP. BYD is now actively developing the 2nd generation of blade batteries with improving costs and energy density. We believe that the external shipment of the power battery will have a brilliant potential since 2021E. We think incremental income from battery external shipment will significantly lift BYD's overall valuation. We expect NP from power battery business will achieve a CAGR of 161% through 2021E to 2025E.
- Semiconductor: a new shining point from BYD's supply chain.** BYD introduced 30 strategic investors into IGBT semiconductor business in Jun 2020 with a post investment valuation of RMB10.2bn. By far, BYD holds 72.3% equity of IGBT business. We are optimistic about its IGBT business given its import substitution potential in China's NEV supply chain. We expect NP from IGBT business will achieve a CAGR of 68% through 2021E to 2025E.
- We are optimistic about the future growth potential of BYD and initiate BUY rating with TP of HK\$100.00 (25.8% upside potential).**

### Earnings Summary

(YE 31 Dec)	FY18A	FY19A	FY20E	FY21E	FY22E
Revenue (RMB mn)	130,055	127,739	148,901	190,449	266,797
YoY growth (%)	22.79%	-1.78%	16.57%	27.90%	40.09%
Net income (RMB mn)	2,780	1,614	2,087	3,112	7,296
EPS (RMB)	0.93	0.50	0.67	1.04	2.58
YoY growth (%)	-34%	-47%	34%	56%	147%
Consensus EPS(RMB)	N/A	N/A	0.97	1.12	1.47
P/E (x)	85.33	159.88	118.95	76.15	30.84
P/B (x)	3.93	3.82	3.69	3.49	3.09
Yield (%)	0.26%	0.08%	0.10%	0.14%	0.34%
ROE (%)	5.05%	2.88%	3.61%	5.15%	11.02%
Net gearing (%)	64%	79%	89%	84%	83%

Source: Company data, Bloomberg, CMBIS estimates

**BUY (Initiation)**

Target Price	HK\$100.00
Up/Downside	+25.8%
Current Price	HK\$79.50

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### Stock Data

Mkt Cap (HK\$ mn)	251,460
Avg 3 mths t/o (HK\$ mn)	564.86
52-week high/low	90/33.46
Total Issued Shares (mn)	915 (H)
	1,813 (A)

Source: Bloomberg, CMBIS

### Shareholding Structure

Wang Chuanfu	18.83%
Lv Xiangyang	8.77%
Bershire Hathaway Energy	8.25%

Source: Company announcement

### Share Performance

	Absolute	Relative
1-mth	22.5%	21.8%
3-mth	71.3%	63.9%
6-mth	59.8%	78.0%
12-mth	50.7%	71.2%

Source: Bloomberg

### 12-mth Price Performance



Source: Wind

### Auditor: Ernst & Young

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<https://euromoney.com/brokers>

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## Why shall we focus on NEV now?

### NEV market has enormous growth potential

**We see enormous growth potential of the NEV market in China.** NEV market in China is shaped under the backdrop of energy structure transformation with an aim to achieve leapfrog development of the China auto industry. China NEV market was initially promoted through heavy subsidy and experienced some disruptions due to government policy changes. Entering into 2020, we think the market is getting mature, since 1) China has formed the world's largest consumer market for NEV; 2) NEV cost has experienced continuous decline and is about to reach cost-parity line by 2023E; 3) government policy has laid a solid foundation, turning from subsidy driven towards non-monetary long-term development mechanism; and 4) NEV upgrade to high-end car model will bring more competitions and opportunities. We project NEV sales volume in China to reach CAGR of 43.4% in 2020-25E, with reference to the Chinese government's ambitious 25% NEV penetration target by 2025E. We think the room for future development of NEV is huge.

### A leapfrog strategy to tackle energy transformation and air pollution

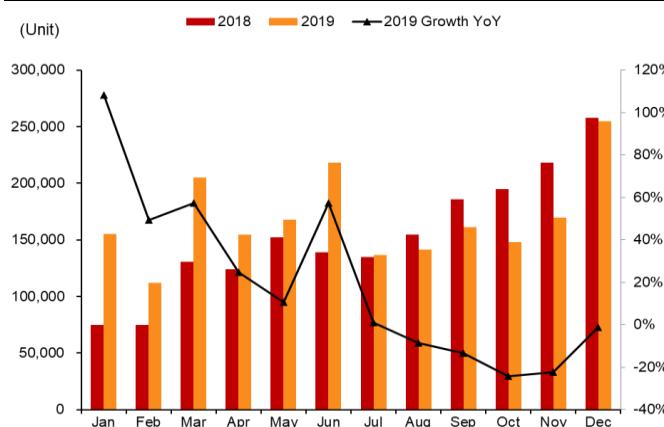
Three main considerations have jointly formed the development strategy of China's NEV industry. 1) From the perspective of energy structure, China's oil import volume is the highest in the world with a dependence ratio of 72%, which affects China's energy security; 2) the serious pollution of fuel vehicles is becoming a demanding issue for Chinese society; and 3) NEV development creates a leapfrog opportunity for China auto industry.

### Subsidy bridge through the path to the world's largest NEV consumer market

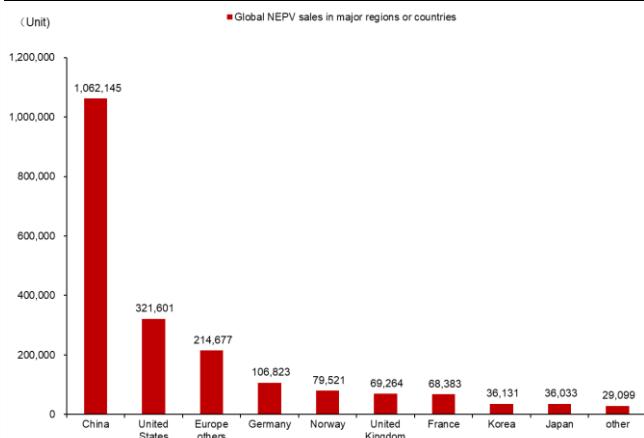
China has ranked No.1 globally in terms of both NEV production and sales for four consecutive years since 2015. The achievements were highly dependent on policy support, however, which as a subsidy to the NEV manufacturers has lowered retail price, helping boost end-users demand.

In the early stages of the development of NEV, we observe the government has expanded demand through industrial policies including fiscal subsidies, purchase tax reductions, and restriction exemption. Since 2019, government has gradually withdrawn direct subsidy while shifting the support from the production side to the user side. The government hopes that the NEV industry can form its own competitiveness competent with ICE and achieve a healthy development in the long run without any government support.

We estimate the central and local governments have provided a total of RMB200-300bn subsidies for NEV industry in the past decade. In 2016, the MoF exposed the fraudulent acts of NEV companies, which caused the government to gradually reduce subsidies from 2017. The adjustment on the subsidy policy has made NEV sales somewhat bumpy in the past two years. However, China still realized NEV sales of 1.062mn units in 2019, accounting for more than 50% of NEV sales of the global market.

**Figure 1: Global NEPV sales in 2018/19**

Source: GGII, CMBIS

**Figure 2: NEPV sales by country in 2019**

Source: GGII, CMBIS

### NEV market is turning from subsidy-driven towards non-monetary policy tools

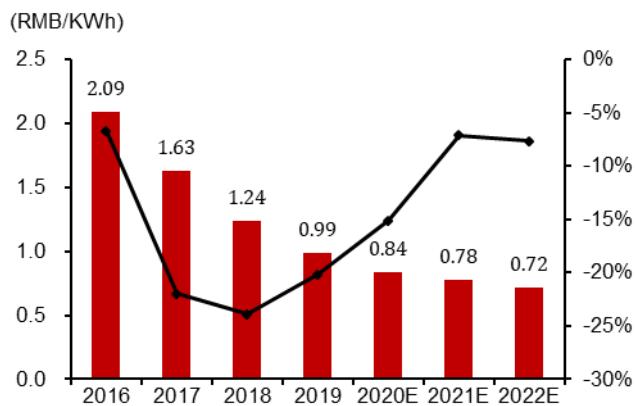
As the domestic NEV market grew relative large enough to support its own development, the government hopes to gradually reduce market intervention. In Jul 2018, China officially relaxed the restrictions on foreign corporation of setting up NEV companies in China. As a result, global NEV leader such as Tesla (TSLA US) started to set up factory in China. By cutting subsidy supports and introducing competition, the Chinese local NEV companies will be forced to accelerate innovation. In the near future from 2021E, non-monetary policy tools such as “CAFC and NEV credit regulation”, will further foster competition and therefore support the development of the NEV industry. We expect China's NEV market to experience a market clearance phase, while China NEV OEMs will likely to face increasing challenges. As the market expands and competition becomes more orderly, we think leading players will benefit from the shifting competitive landscape.

### Cost reduction is the most critical factor in NEV industry

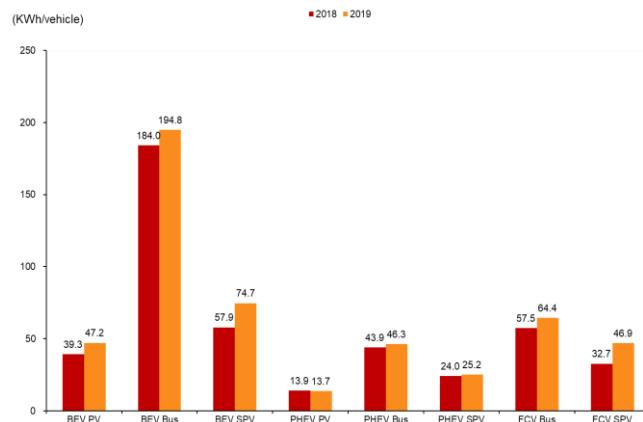
Subsidy cuts substantially amplify the pressures of cost reduction in the NEV industry. The essence of the industry is to continuously improve cost structure through technology advancement and the economies of scale brought by growing demand.

The manufacturing cost of NEV includes three major electric components (namely battery, motor, and electronic control), automotive electronics, body, chassis suspension, interior decoration, etc. Among them, batteries, motors and electronic controls constitute three major components in the NEV industrial chain. In 2019, power batteries accounted for about 40% of vehicle manufacturing costs. In other words, the cost of the power battery will directly affect the manufacturing cost of NEV. Therefore, the cost reduction pace of power battery directly determines the future development speed of NEV. Given 1) increasing economies of scale with growing demand; 2) the improvement in the first-pass yield due to the improvement of production technology; and 3) an expected cost reduction in raw material, we expect that the unit cost of the battery would continue to decline.

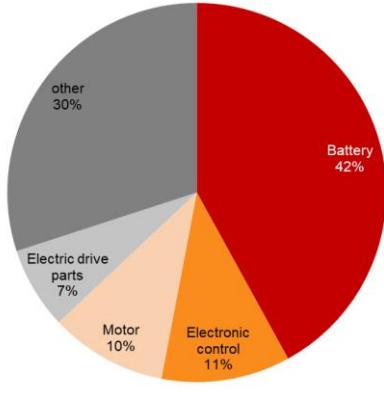
According to GGII, the price of power batteries has been declining at an annual rate of about 20% in past 5 years. At the end of 2019, the ex-VAT price for the ternary battery system(pack) was RMB0.95-1.05/Wh while the price for the LFP system(pack) was RMB0.85-0.95/Wh. It is expected that the ternary battery pack ex-VAT price will drop below RMB0.90/Wh while the LFP pack ex-VAT price will drop below RMB0.8/Wh in 2020E. Based on a diminishing path of battery cost, we estimate the costs parity to ICE can be reached as early as 2023E.

**Figure 3: Average power battery price declined fast in 2016-19**


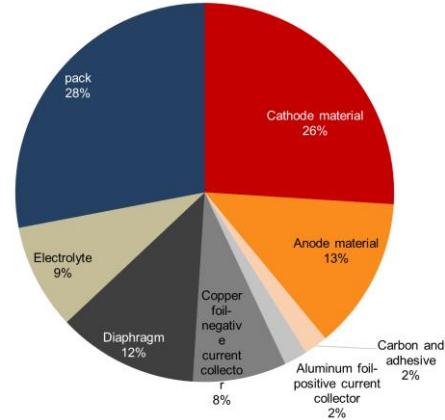
Source: GGII, CMBIS estimates

**Figure 4: Power battery capacity installed by vehicle type**


Source: GGII, CMBIS

**Figure 5: BEV cost breakdown in 2019**


Source: Gasgoo, CMBIS

**Figure 6: Power battery cost breakdown in 2019**


Source: Bloomberg, CMBIS

## Government policy laid a solid foundation for long-term development

The Chinese government has provided enormous support from the very beginning of the NEV development in the country. In Sep 2001, MIIT has set up a special project for EV within the national "863" plan during the "Tenth Five-Year Plan" period. However, we observe that the first rapid growth period of the China NEV industry began in 2012. Since the "Energy Saving and New Energy Vehicle Industry Development Plan (2012-2020) 《节能与新能源汽车产业发展规划（2012—2020 年）》" was issued by the State Council and implemented in 2012, China NEV market has entered into a new phase.

Going forward, we think recent government policies laid a solid foundation to drive the NEV industry's sustainable growth. For the near term, MIIT official just extended the financial subsidy for NEV by three years to end-2022 on 23 Apr 2020. For the longer-term, MIIT released the "New Energy Vehicle Industry Development Plan (2021-2035)" (draft for comments) on 3 Dec 2019,. According to the "Plan", China will set an ambitious target to have NEV/Intelligent connected vehicles(ICV) sales volume accounting for 25%/30% of total vehicle sales by 2025E. On 23 Jun 2020, a new version of "CAFC and NEV credit regulation" was published, with rigorous mechanism designed to promote the future growth of the NEV industry and to underpin the 2025E target.

**Figure 7: Summary of national subsidy scheme**

Range (NEDC, km)	2016	2017	2018	2019	2020E	2021E	2022E	2023E
100≤R<150	25,000	20,000	-	-	-	-	-	-
150≤R<200	45,000	36,000	15,000	-	-	-	-	-
200≤R<250	45,000	36,000	24,000	18,000	-	-	-	-
250≤R<300	55,000	44,000	34,000	18,000	-	-	-	-
300≤R<400	55,000	44,000	45,000	18,000	16,200	12,960	9,072	-
400≤R	55,000	44,000	50,000	25,000	22,500	18,000	12,600	-
PHEV	30,000	24,000	22,000	10,000	9,000	7,200	5,040	-
Retreat %	-20%	14%	-50%	-10%	-20%	-30%	-100%	

Source: MIIT, CMBIS

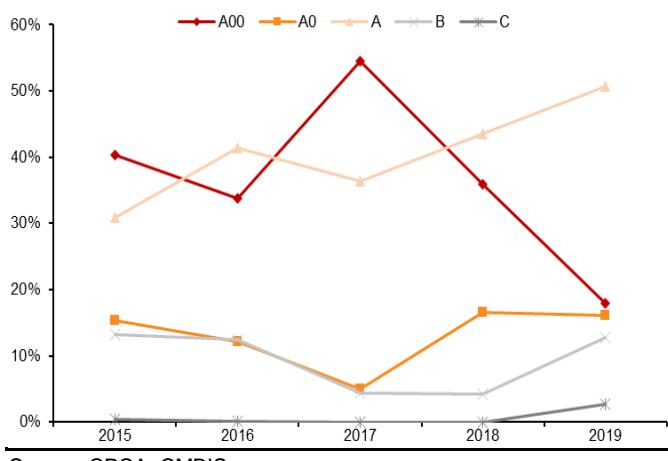
## NEV to break through to high-end vehicles

**We believe Year 2020 will become a starting point for NEV upgrade.** The proportion of A00-class NEV sales has begun to decline since 2017. Sales penetration rate of the A-00 class NEV declined from 54% in 2017 to 18% in 2019. Meanwhile, the proportion of A-class NEV sales gradually increased from 36% in 2017 to 51% in 2019. Market share of B/C-class NEV cars also rose from 4%/0% in 2018 to 13%/3% in 2019. **The breakthrough of NEV towards high-end vehicles reflects that consumers have begun to recognize NEV as comparable with ICE.**

In 2019, the Tesla Shanghai plant's commencing production marked the official localization of Model 3. At the same time, we also observe that many big names in ICE were also accelerating the pace in electrification. For example, BBA (Daimler EQ series, BMW i series, and Audi e-tron series) have accelerated its electrification strategies from 2020. We expect a number of new models at different class-levels to be roll out by a variety of OEMs, forming a complete product line in NEV industry. The market is expecting the B/C class EV market will start to compete with ICE from 2020.

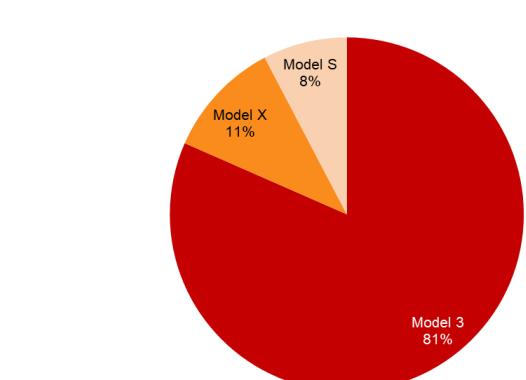
We believe the breakthrough will likely intensify competition between NEV manufacturers and ICE OEMs, but this will also create opportunities such as significantly increasing the NEV market sales volume as well as ASP boom with increasing high-end vehicle sales.

**Figure 8: NEPV sales in China by class**



Source: CPCA, CMBIS

**Figure 9: Tesla global sales by model in 2019**



Source: EV Sales, CMBIS

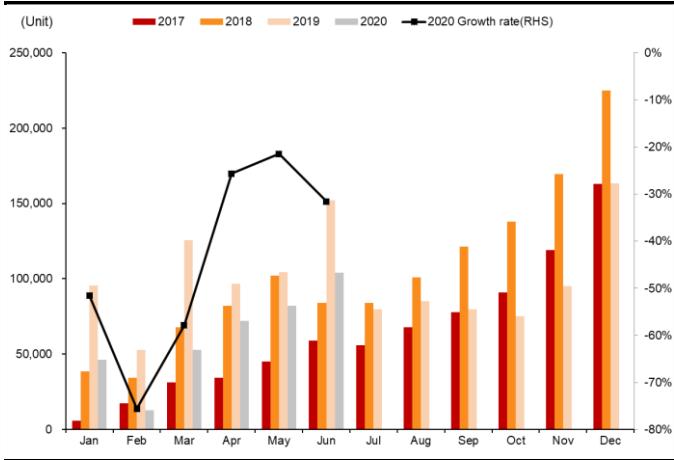
## NEV sales to reach 6.22mn units in 2025E with a CAGR of 43% in 2020-25E

### Short-term bumpy: EV sales to decline 15% YoY to 1.02mn units in 2020E

We expect the NEV sales to be 1.02mn units in 2020E, down 15% YoY. In 2019, China's NEV production/sales were 1.24mn/1.21mn units, down 2.3%/4.0% YoY, respectively. Looking back on 2019, the subsidies for NEV experienced a steep decline with a maximum retreat of more than 50%, due to the subsidy transition period exited at the end of Jun 2019. As a result, the rising retail price of NEV affected its relative competitiveness compared with ICE. Since Jul 2019, NEV sales started a path heading south until the end of 2019. Oct and Nov 2019 read dramatic decline of 46% and 44% YoY, respectively.

At the beginning of 2020, CAAM forecasts that China's NEV sales will be about 1.20mn units in 2020E at similar level as in 2019. However, since the supply side was seriously disrupted, the total output in 1H20 has declined by 36.5% YoY. While demand had disappeared given the negative income effects affected by COVID-19 in 1Q20, NEV sales volume recorded only 393K in 1H20, down 37.4% YoY. As we expect policy support measures should underpin the sales performance, we believe NEV will achieve an increase of 10% YoY in 2H20E. As a result, we revise down our NEV sales forecast to 1.02mn units in 2020E, a decline of 15% YoY.

**Figure 10: NEV monthly sales in China**



Source: CAAM, CMBIS

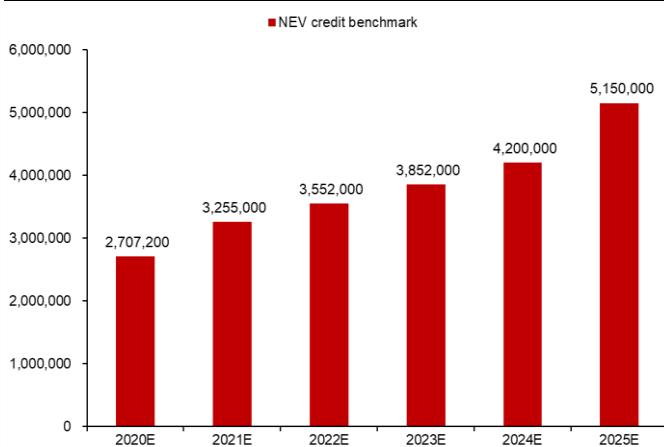
**Figure 11: Monthly PV sales in China**



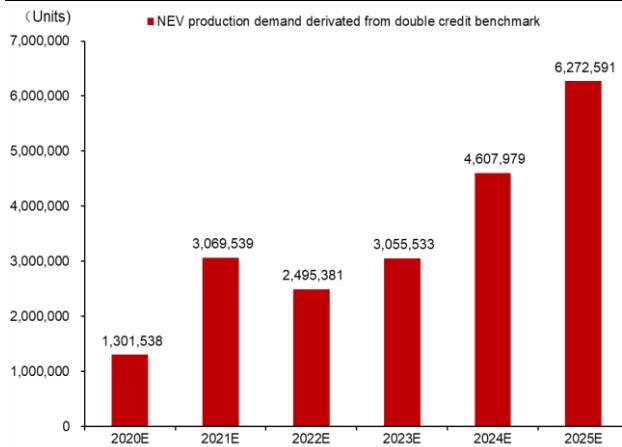
Source: CAAM, CMBIS

### Medium-term growth to accelerate with a jump in 2021E

Although the subsidy retreats in 2020 are better than previously expected, three critical factors, namely "reducing costs, improving battery life, and ensuring safety" will still be the key tasks for the whole NEV industry in the medium-term, which will likely prompt technological progress and meet customer demands. As we forecast below, NEV production and sales volume derived from "double credit regulation" will jump significantly in 2021E, making 2020E a perfect stage to accumulate related shares in NEV sector.

**Figure 12: NEV credit benchmark forecast**

Source: MIIT, CMBIS estimates

**Figure 13: Production derived from double credit**

Source: MIIT, CMBIS estimates

### Long-term growth to be enormous with 43% CAGR in 2020-25E

Even though the cost of NEV will gradually decrease in the next three years, the retail price will still be higher than the same grade of ICE without any subsidy. Given full recognition of this fact, the government has already extended the subsidy by three years as compared with the initial plan in 2020. Beyond financial subsidy, we expect that other trends such as (1) double credits; (2) technical support; (3) battery charge subsidy at the operation side may provide additional support.

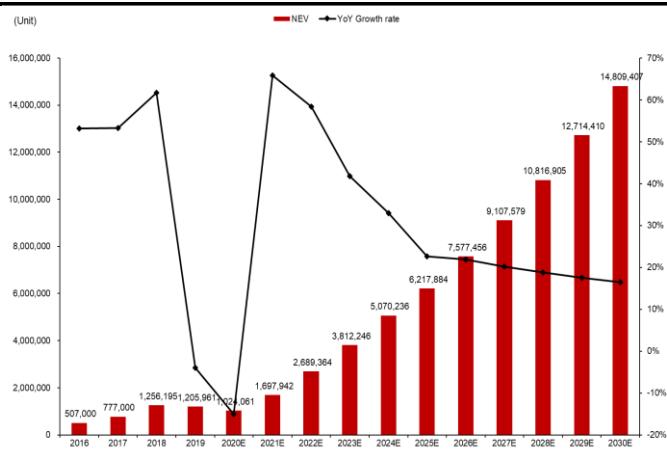
As we mentioned earlier, we expect the cost parity with ICE will be achieved between 2023E and 2025E in terms of production cost. According to "Research on the Development Trend of Chinese Traditional and New Energy Vehicles 2050" from CATARC, it will take 5 to 10 years to reach cost parity with ICE in terms of comprehensive cost. Therefore, we believe that a surge in sales volume of NEV may happen in the coming 3-5 years as the cost gap is shrinking rapidly. The market share of NEV will expand at accelerated speed when cost parity nearly achieves.

We expect the real demand, especially A to C class NEV, will start to release shortly from 2020. As a result, both ASP for NEV and for components (power battery/IGBT) will rise as the proportion of higher-class increases.

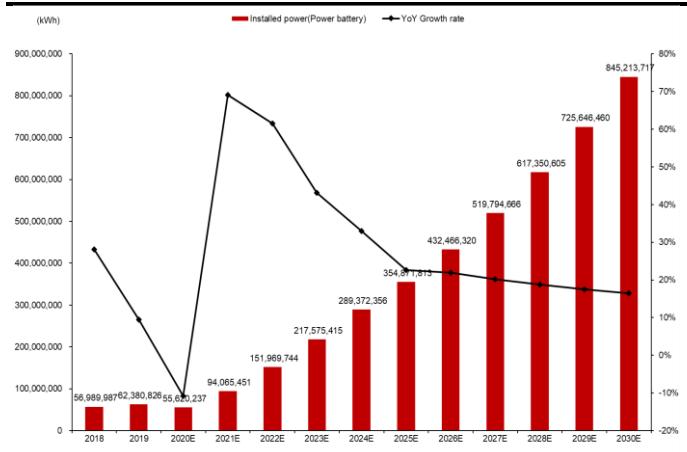
Starting from 2023E, we expect NEV sales volume to grow at an increasing speed with improving sales structure. We take the penetration rate of 25% in 2025E set by MIIT as given. **We expect that the sales volume of NEV in China will be 6.22mn units in 2025E with a CAGR of 43% between 2020E and 2025E. Both NEV OEMs and related NEV parts/components companies will benefit from the future rapid growth, in our view.**

**Figure 14: Global NEV forecast by IEA**

Source: IEA, CMBIS

**Figure 15: NEV sales forecast in China**

Source: CAAM, CMBIS estimates

**Figure 16: Power battery installed forecast in China**

Source: GGII, CMBIS estimates

## Why do we prefer BYD?

BYD is one of the first few auto OEMs that invested in the NEV in China. The Company has accumulated a great amount of technical knowledge while earning increasing brand recognition. BYD has established leading market position in NEV sales. In 2019 in terms of sales volume in a global context, BYD was ranked No.2 for total NEV sales; No.3 for BEV sales; and No.1 for PHEV sales. We think BYD is well in the position to embrace the opportunities that will arise with the enormous growth potential from the NEV market.

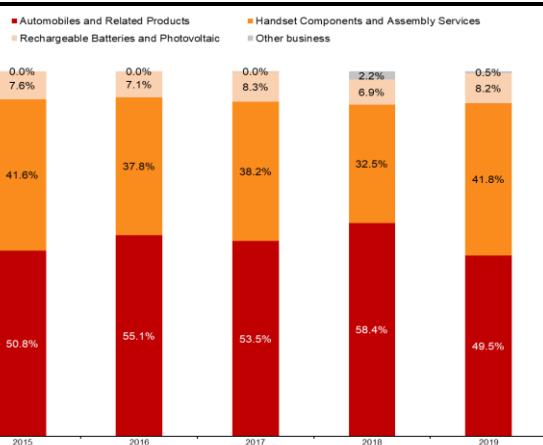
As a conglomerate, BYD is in the leading position in numbers of its business area, such as NEV, power battery, IGBT, Cloud rail, Headset electronics, etc. In 2020-21E, we think BYD has several eye-catching highlights, sequence by

- 1) releasing DM4.0 platform in 4Q20 to defense and enlarge its NEV market shares through PHEV;
- 2) new launching cycle from 2H20E, especially its flagship model, "Han" to boost NEV sales volume;
- 3) launching the new blade battery could be a potential game-changer in the power battery market;
- 4) opening up battery supply to external customers from its "FinDreams" supply chains; and
- 5) introducing strategic investors, and expressed the intention to sell its IGBT module externally

### The business: Auto segment accounts the most for revenue and gross profit contribution

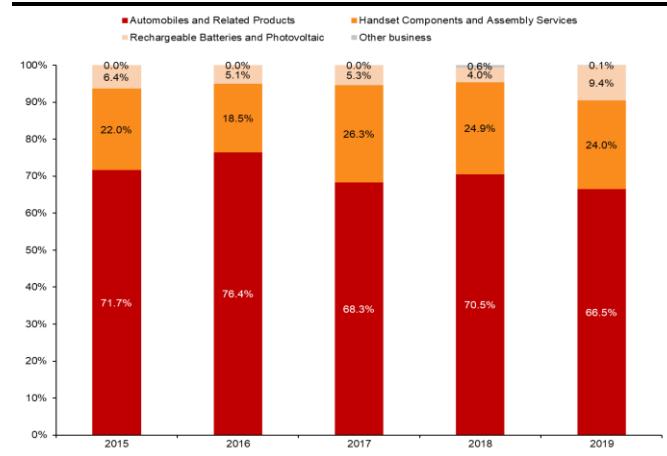
BYD's main business can be divided into Automobiles and Related Products (internal combustion engine and new energy vehicles), Handset Components and Assembly Services, Rechargeable Batteries and Photovoltaic, and Other business (urban rail transportation). In 2019, the Company achieved sales revenue of RMB127.7bn, of which 49.5% came from the auto and parts, 41.8% came from the handset components and assembly business, 8.2% came from the secondary rechargeable battery business (excluding car power batteries), and the remaining 0.5% came from other main businesses (include cloud rail). In 2019, GP was RMB20.8bn, of which 66.5% came from the auto and parts, 24.0% came from the handset components and assembly business, 9.4% came from the secondary rechargeable battery business (excluding car power batteries), and 0.1% came from other main businesses (include cloud rail).

**Figure 17: Sales breakdown**



Source: Company data, CMBIS

**Figure 18: GP breakdown**



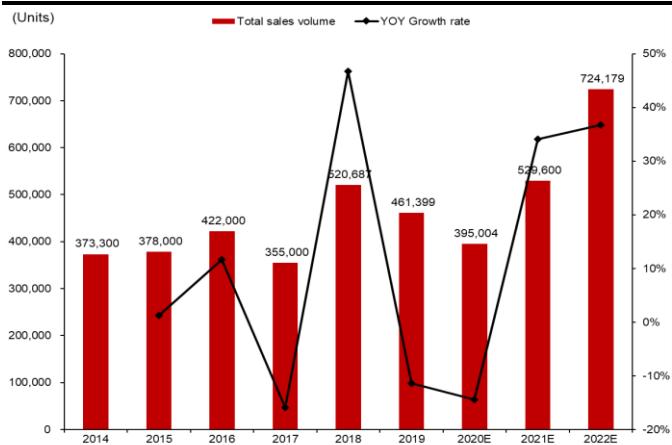
Source: Company data, CMBIS

## Auto - Leading market position in NEV market

The automotive segment includes two parts, internal combustion engine (ICE) and new energy vehicles (NEV). BYD's ICE sales was generally following a declining trend from 2014 to 2019 with squeezed market shares due to intensified market competition. In reverse to ICE, NEV sales was following an increasing trend, experienced rapid growth from 2015 to 2018. NEV will be our key focus in the automotive segment.

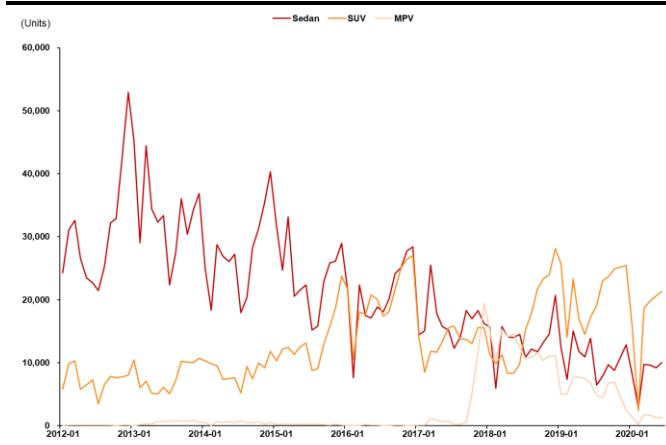
The Company has sold a total of 461.4K vehicles in 2019, a decrease of 11.4%YoY, due to the overall market slowdown. Among the total sales, 231.9K of which are ICE, down 15.0%YoY whereas 229.5K of which are NEV, down 7.4%YoY. In the field of ICE, SUV accounts for 52%; MPV accounts for 27%; and sedan accounts for 21% in terms of sales volume. In 2019, auto business achieved revenues of RMB63.3bn, a drop of 16.8%YoY.

**Figure 19: Total sales volume**



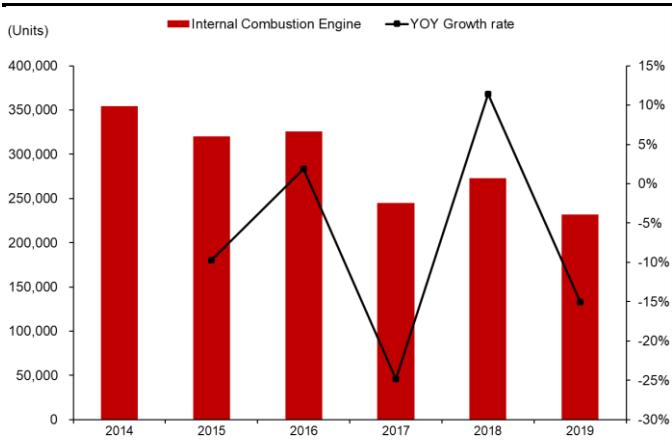
Source: Company data, CMBIS estimate

**Figure 20: Sales trends by vehicle type**



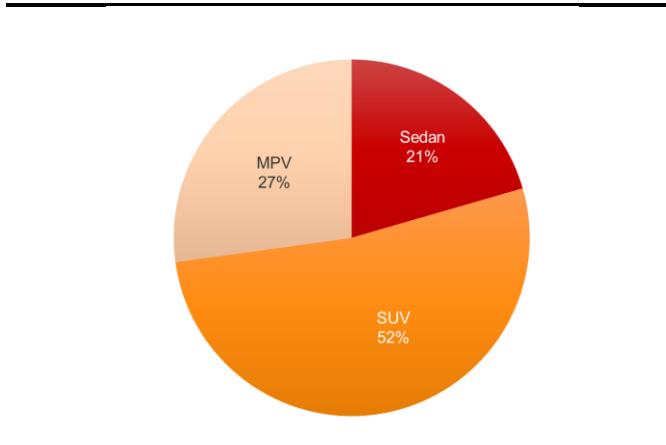
Source: CPCA, CMBIS

**Figure 21: ICE sales volume**



Source: Company data, CMBIS

**Figure 22: ICE sales by vehicle type in 2019**



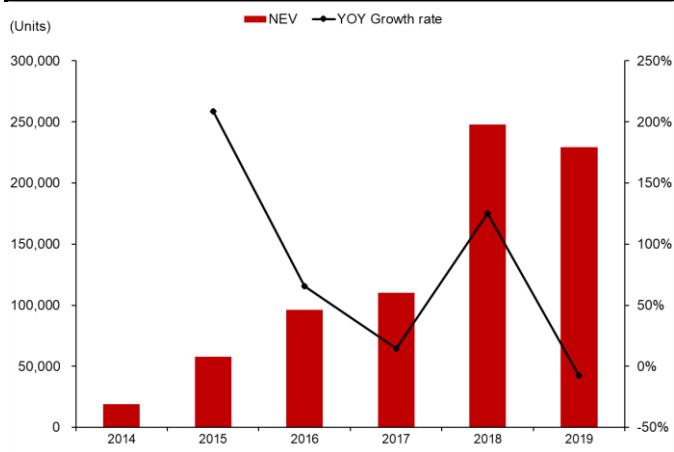
Source: Company data, CMBIS

## ■ NEV Highlight 1 – Comprehensive NEV types and technical routes

**BYD is one of the first few auto OEMs that invested in the NEV in China.** Given first-mover advantage, the Company has accumulated a great amount of technical knowledge while earning strong brand recognition. The Company has a high-level strategic agenda, namely "7+4", covering seven types of vehicles such as PV, city bus, taxis, logistics, etc. and in four application scenarios such as warehousing, ports, airports, and mines. In 2019, BYD was ranked No.2 globally in terms of NEV sales volume. Among them, its BEV was ranked No.3 while PHEV ranked No.1 globally.

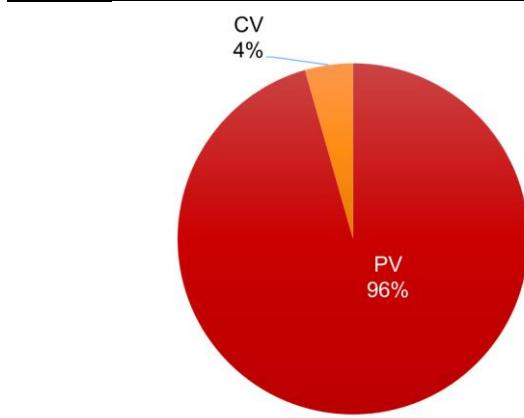
In 2019, PV accounted for 96% of its NEV sales while CV accounted for 4%. Its market share in China has perfectly reflected BYD's first-mover advantage and great product recognition. In 2019, BYD ranks No.1 in the NEPV market with a market share of 21%. In addition, BYD ranks No.4 in the NEV bus market with a market share of 8%.

**Figure 23: NEV sales volume**



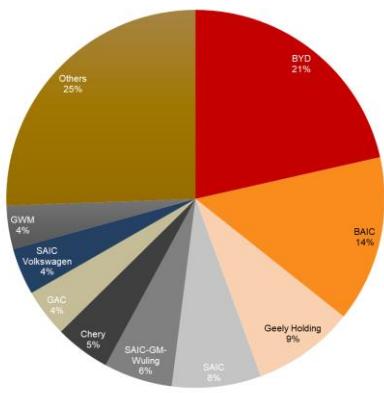
Source: Company data, CMBIS

**Figure 24: NEV vehicle sales by type in 2019**



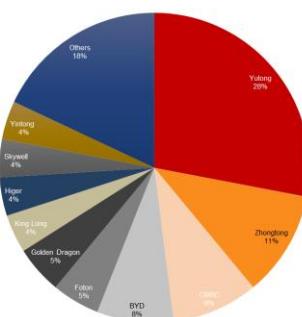
Source: Company data, CMBIS

**Figure 25: NEPV market share in 2019**



Source: GGII, CMBIS

**Figure 26: NEV bus (6 meter+) market shares in 2019**



Source: 360buses, CMBIS

In the NEPV field, BYD has two series models, namely Dynasty (Qin, Tang, Song, Yuan, etc) and e series (e1, e2, S2). Dynasty models are priced ranging from RMB70K to RMB260K. In 2019, BYD launched its e series, including e1/e2/e3/S2, which will focus on mass-market with a price range at RMB60K to RMB140K. In Jul 2020, BYD launched a brand new model, Han, with a price range from RMB220K to RMB280K. **The new models**

have enriched the product matrix and filled-in the product gap in the lower-/higher-end, which is expected to bring new growth.

In the NECV field, the main products include EV bus, EV coach, EV trucks and special CV, etc. BYD has chosen BEV strategy in its CV market. Up to now, BYD has successfully sold its EV bus in six continents and more than 50 countries, reflecting its global presence and brand recognition.

**Figure 27: Product matrix**

EV	Hybrid	Fuel	CV
Tang EV	Tang DM	Tang	K6/7/8/8S/9
Song Pro EV	Song DM	Song/Song Pro	e5/6
Song Max EV	Song Max DM	Song Max	C6/7/8
Qin Pro EV	Qin Pro DM	Qin Pro	T3/4/5/7
Qin EV/EV 450	Qin DM	Qin	Special CV
Yuan EV/EV360	<b>Han DM(NEW)</b>	F3	
e1/2/3		SuRui	
S2			
<b>Han EV(NEW)</b>			

Source: Company data, CMBIS

**Figure 28: Qin**



Source: Autohome, CMBIS

**Figure 29: Tang**



Source: Autohome, CMBIS

**Figure 30: Song**

Source: Autohome, CMBIS

**Figure 31: Yuan**

Source: Autohome, CMBIS

**Figure 32: Han**

Source: Autohome, CMBIS

**Figure 33: e5(Taxi version)**

Source: Autohome, CMBIS

### ■ NEV Highlight 2 – Introduce international talents to improve product power

**BYD introduces international talents to the team.** As a Chinese company that goes global, BYD actively seeks talents with different cultural backgrounds. They specialize in areas of vehicle design, interior, and exterior decoration, NVH, chassis adjustment, etc. The table below summarizes credentials of international experts and their responsible areas. By hiring globally, BYD is able to absorb different ideas and enhance its product performance and customer recognition.

**Figure 34: International experts in different fields**

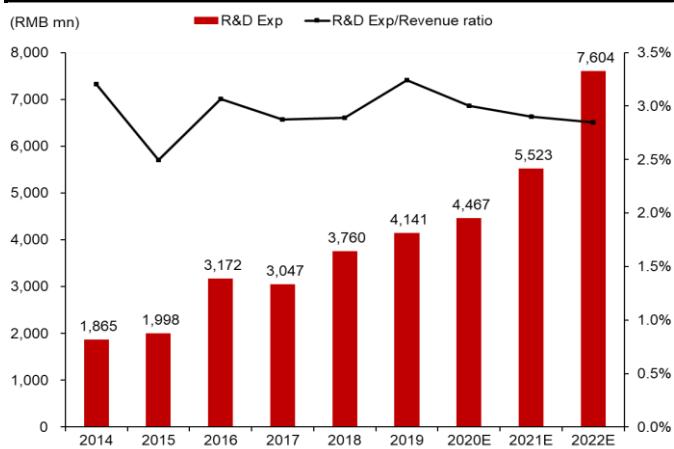
Designer	Responsible Area	Former Employer
Wolfgang Egger	Design "Dragon Face"	Audi
JuanMa Lopez	Exterior	Ferrari
Michele Jauch-Paganetti	Interior	Mercedes Benz
Heebum CHA	NVH	Geely
Heinz Keck	Chassis adjustment	Mercedes Benz
Kevin E Wale	Strategy	GM

Source: Company data, CMBIS

### ■ NEV Highlight 3 – High R&D Investment

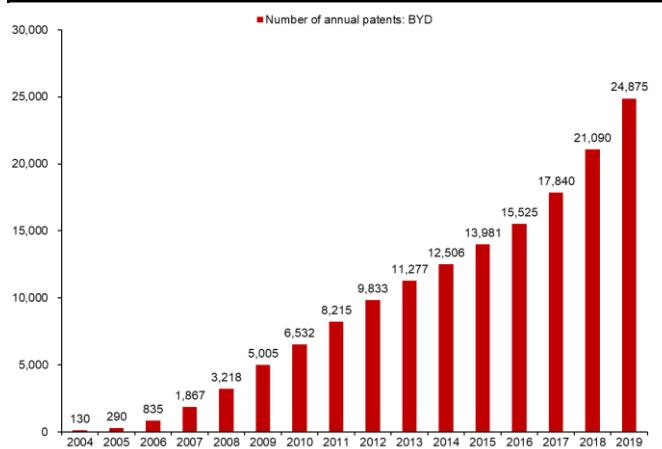
**BYD has been consistently invested in cutting-edge technology.** In 2019, the Company has R&D expenses of RMB4,141mn, representing 3.24% R&D expense to revenue ratio, which was the highest since 2014. The annual patents of BYD increased 24,875 in 2019 from 130 in 2004, as a result of heavy R&D investments. BYD also accumulated various technology advantage such as vehicle manufacturing, power battery, and IGBT chip, etc.

**Figure 35: R&D Expense/Expense ratio**



Source: Company data, CMBIS

**Figure 36: Number of patents**

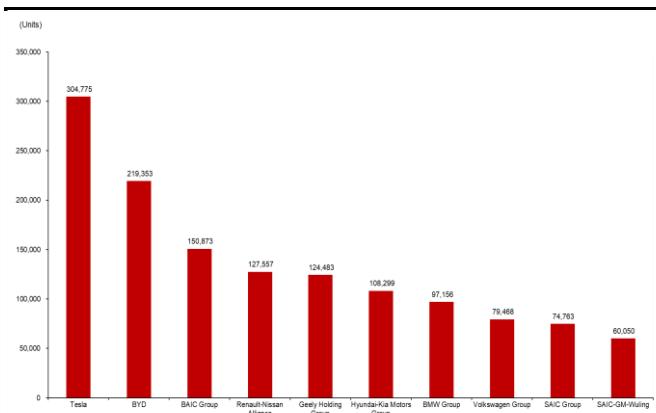


Source: Sipo, Wind, CMBIS

### ■ NEV Highlight 4 - DM4.0 Technology

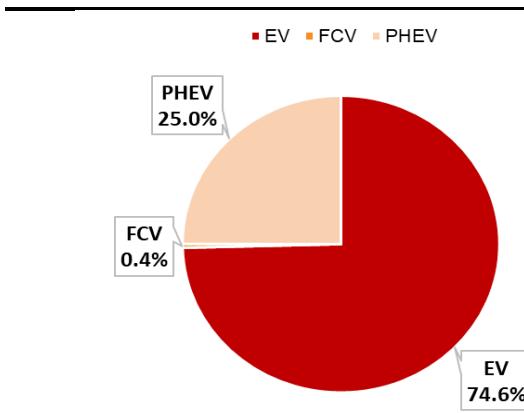
**We believe PHEV will outperform BEV in the overall NEV market in medium-term given 1) policy shift; 2) cost advantage and 3) persistent mile range anxiety.** Wan Gang, Minister of Science and Technology, said that "the development of a high-efficiency electromechanical hybrid system is the direction of our NEV". Recent updates on the "Double credit" policy also tilts more to PHEV. It is commonly believed that PHEV will reach cost parity sooner than that of BEV by the market. We also expect the mile range anxiety will last in the future for a considerable period. We think consumers would prefer PHEV in which BYD has a comparative advantage. Among the global NEV sales in 2019, BEV/PHEV/FCV accounted for 74.6%/25.0%/0.4% respectively. We expect PHEV to enlarge its overall shares in the medium-term.

**Figure 37: Global NEPV ranking by auto group in 2019**

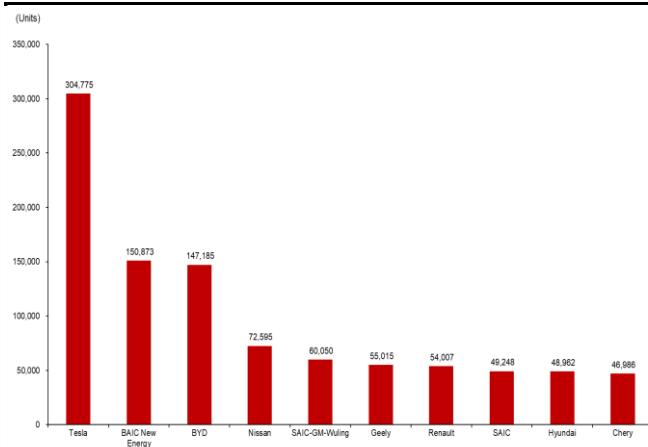


Source: GGII, CMBIS

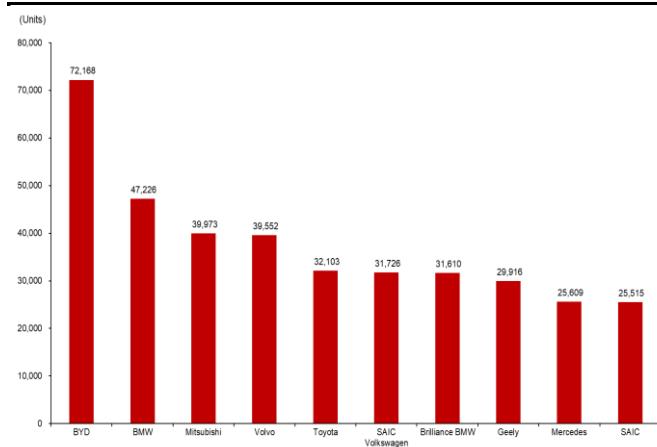
**Figure 38: Global NEPV sales by technology routes in 2019**



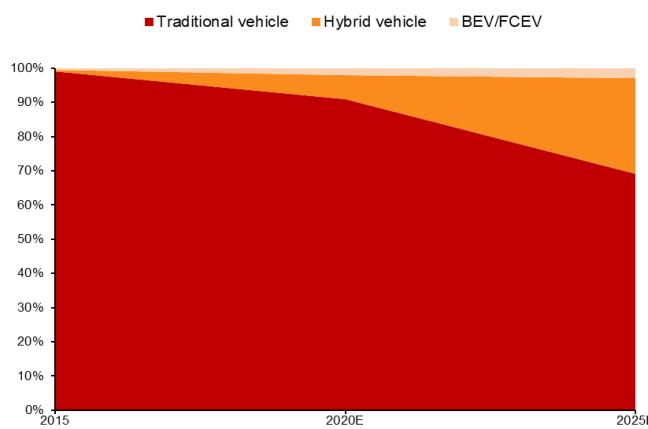
Source: GGII, CMBIS

**Figure 39: Global BEV PV sales ranking in 2019**

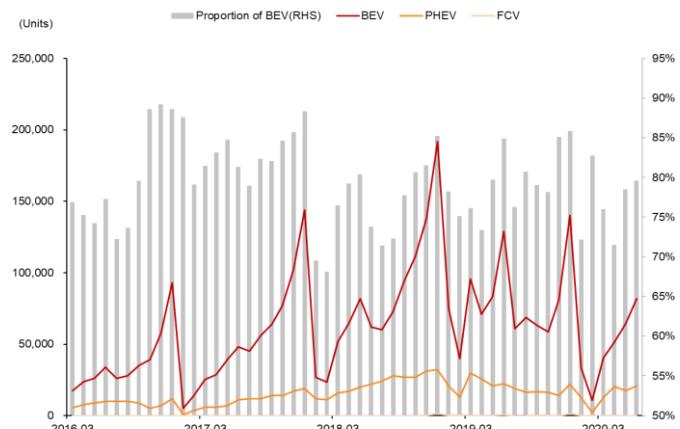
Source: GGII, CMBIS

**Figure 40: Global PHEV PV sales ranking in 2019**

Source: GGII, CMBIS

**Figure 41: Technology route forecast by IHS Markit**

Source: IHS Markit, CMBIS

**Figure 42: Sales by power type in China**

Source: Wind, CMBIS

**In addition to overall PHEV market growth, BYD also has cutting-edge dual-mode technology to support PHEV products.** BYD expects to launch its 4th-generation PHEV technology, Dual-Mode 4.0(DM4.0), in 4Q20E. DM4.0 consists of DM-p and DM-i platforms. DM-p will shape its focus on power output. Han DM will be the first model equipped with a DM-p platform. DM-i platform mainly focuses on the cost economy. We believe DM-i will likely to help achieve the cost parity with ICE. If BYD can successfully achieve this goal, it will help the Company 1) reiterate its brand recognition; 2) expand its market share by utilizing the cost advantage. We expect BYD PHEV will have a strong performance and will regain market share in 2021E prompted by new car models equipped with DM4.0 to launch.

### ■ NEV Highlight 5 – To B business

**BYD takes advantage of its first-mover advantage and has a strong economic moat in the fields of EV taxi, EV ride-hailing vehicle, and EV city bus.** For example, in 2019, about 60K units of EV were sold to operating entities, accounting for 27% of its NEPV sales volume. It commonly believes that the replacement cycle for a taxi is six years. If we mark 2015 as the beginning of the electrification among China's operating vehicles, we expect that China's EV taxis/ride-hailing vehicle will start the first renewal cycle with an annual

proportion of 10-15% in the short-/medium- term. BYD, as the first batch of companies that provide EV operating vehicles, will maintain a competitive advantage in the B field.

## ■ NEV Highlight 6 – new launching cycle in 2H20E–2021E

**Launching blade batteries and Han models will be marked as the origin of the new product cycle, in our view.** Han, a flagship B+ class vehicle, has accumulated over 20K bookings as of now. We believe the monthly sales of Han will reach 3K to 4K with a potential surprise. As previously mentioned, all DM models will equip with DM4.0 in later 2020E. A new product cycle will revert its less-than-demanding performance in 1H20.

## ■ Sales forecast

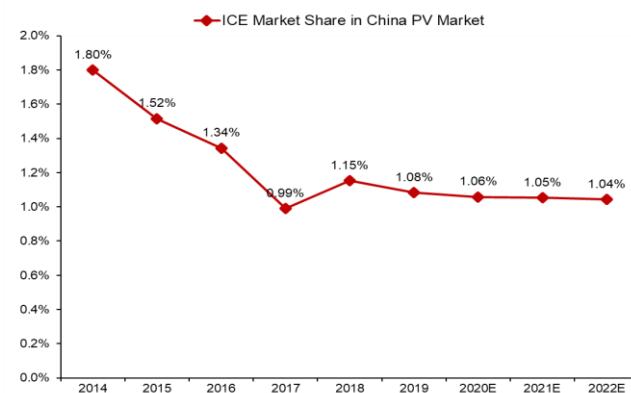
BYD's NEV market share declined slightly from 19.7% in 2018 to 19.0% in 2019, due to subsidy withdrawal which brought negative impacts to NEV sales. **However, given the six advantages discussed above, we expect BYD to start regain market share in the NEV sector as the NEV market normalizing back to its trajectory.** We expect its market share in the NEV market will bounce back from 18.2% in 2020E to 18.8%/19.1% in 2021E/22E. In terms of ICE, we expect BYD also to slightly lose shares as market competition intensifies.

**Figure 43: Market share in China NEV Market**



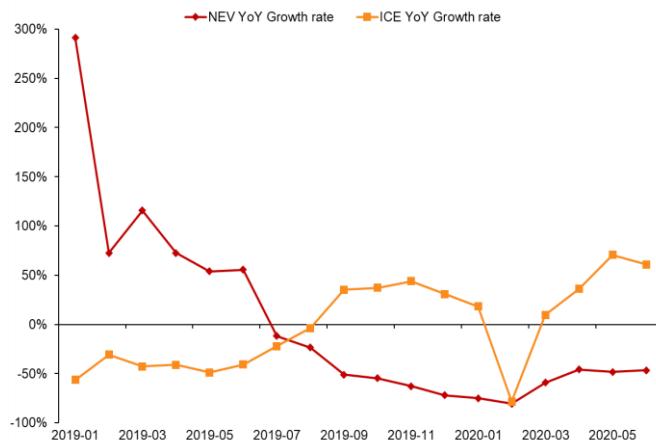
Source: Company data, CMBIS estimate

**Figure 44: ICE market share**



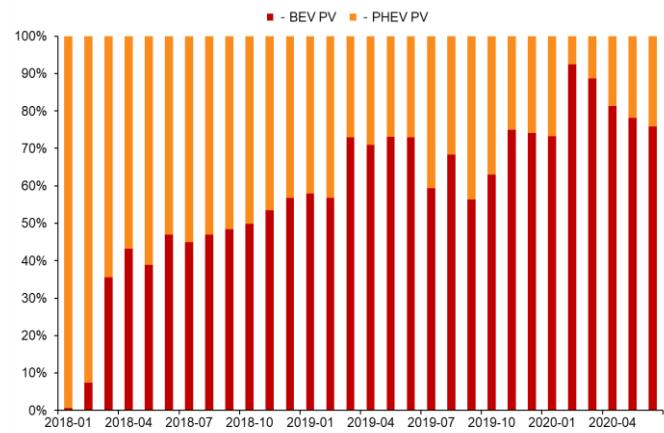
Source: Company data, CMBIS estimate

**Figure 45: Monthly sales: YoY growth**

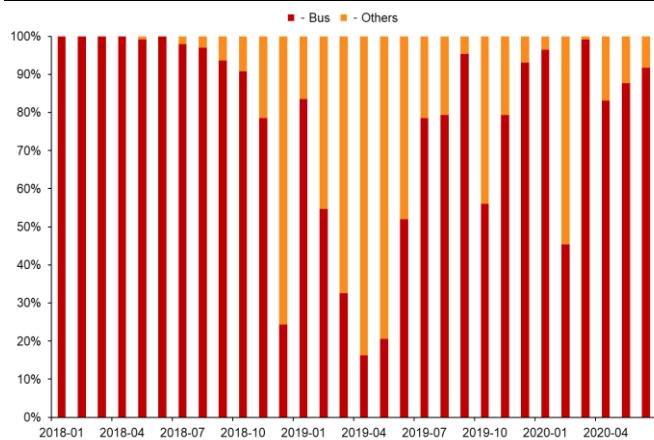


Source: Company data, CMBIS

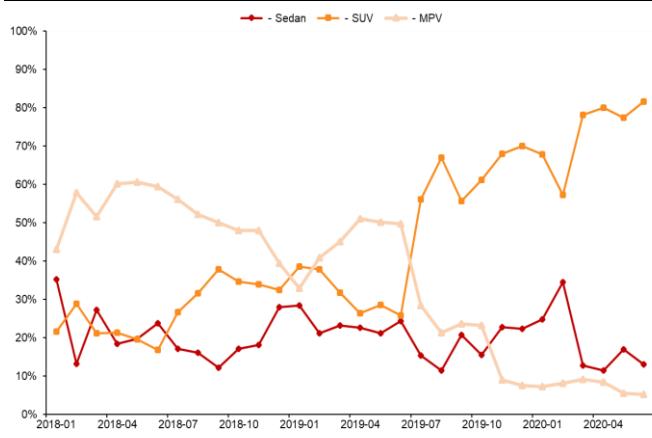
**Figure 46: NEPV sales proportion by power type**



Source: Company data, CMBIS

**Figure 47: NECV sales proportion by vehicle type**

Source: Company data, CMBIS

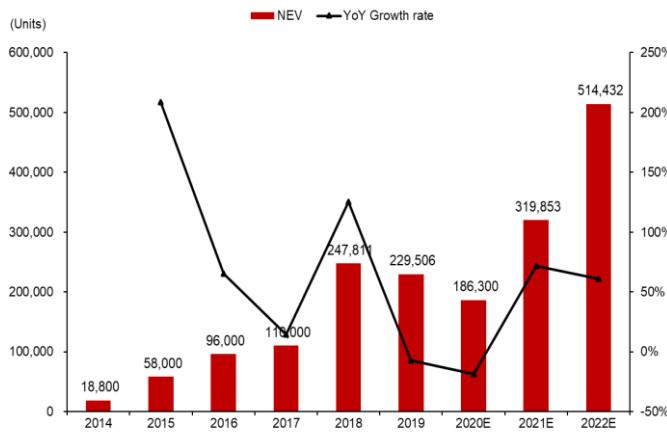
**Figure 48: ICE sales proportion by vehicle type**

Source: Company data, CMBIS

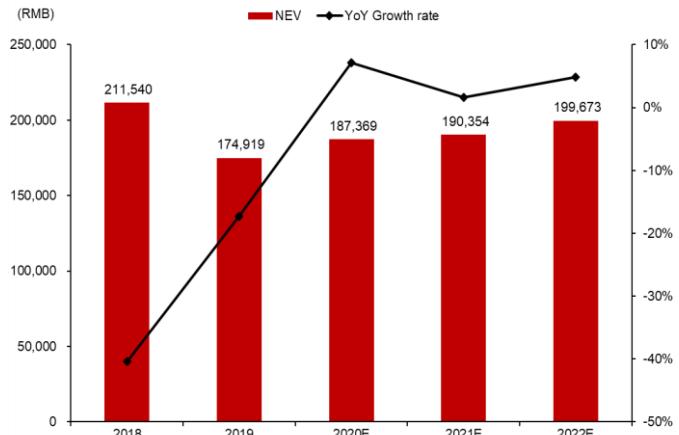
## ■ Financial forecast

Affected by multiple factors such as the emission standard switch/subsidy retreat, NEV sales in China were only 1.21mn units in 2019, down 4.0% YoY. BYD's NEV sales volume was 230K in 2019, representing a decrease of 7.4%YoY. Affected by COVID-19, we think the sales of NEV in China in 2020E will face great pressure as in 2019. However, we have already observed that the central government had extended the subsidy schedule until 2022E from its original subsidy exit plan of 2020E. In addition, a variety of regions have also introduced a local subsidy to boost NEV purchase in 2020E. Therefore, we expect the sales volume of NEV in China will be to 1.02mn units, a strong rebound from 1H20, but still indicating a decrease of 15%YoY.

**We believe that BYD's launch of new batteries (Blade battery) and new models(Han) will support its overall sales.** BYD will also release its DM4.0 version PHEV across its all major models in 4Q20E. At the same time, Guangdong and Shenzhen have introduced NEV subsidy policies that will likely to support BYD's NEV sales. Even though BYD's NEV sales underperformed the market in 1H20, we remain confident in its performance in 2H20 and going forward. We expect BYD's new car model launching cycle with cutting the edge technologies will help the Company further improve its brand recognition, which will support NEV sales. In 2020E, we forecast NEV will have a sales volume decline of 19% YoY (NEPV -19%/NECV -10%) with NEV sales volume of 186.3K units. We forecast ASP for NEV will rise by 7% in 2020E as vehicle type/product mix changes. In 2021-22E, we expect NEV sales volume to pick up rapidly to 319.9K/514.4K unites, respectively, while ASP to maintain upward trends as NEV sales shift to high end models.

**Figure 49: NEV Sales forecast**

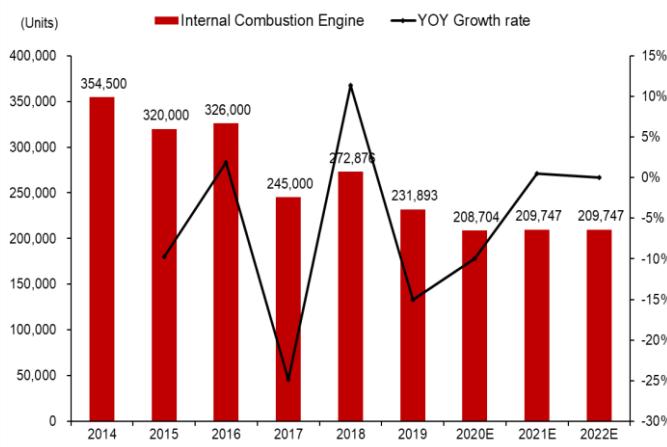
Source: Company data, CMBIS estimate

**Figure 50: NEV ASP forecast**

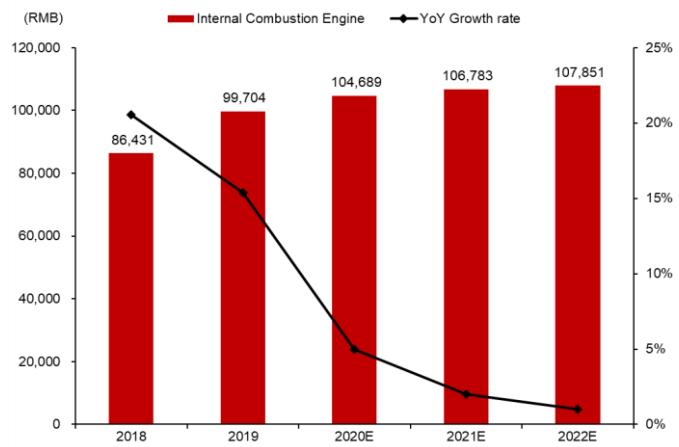
Source: Company data, CMBIS estimate

### For ICE, we expect the rollout of Song Plus will underpin the ICE performance.

Specifically, we expect the sales volume of its ICE will be 209K in 2020E, a decline of 10%YoY. We expect the ASP for ICE will increase slightly to RMB105K in 2020E, an increase of 5.0%YoY as the proportion of higher-class product increases.

**Figure 51: ICE Sales forecast**

Source: Company data, CMBIS estimate

**Figure 52: ICE ASP forecast**

Source: Company data, CMBIS estimate

**The aggregate sales volume will grow at -14.4%/34.1%/36.7% to 395K/530K/724K in 2020E/21E/22E.** The aggregate ASP will grow at 5%/9%/10% to RMB144K/157K/173K in 2020E/21E/22E. As a result, we forecast the new car sales revenue will maintain a growth rate at -10%/47%/51% to RMB57/83/125bn in 2020E/21E/22E.

## NEV parts business

**BYD was one of the auto OEMs that invested heavily in the NEV field and has increasingly shifted its focus to NEV business.** With the continuous investment in R&D, the Company has accumulated technical advantage in the core technology of NEV supply chains such as power battery and IGBT. Beside, BYD also has technological accumulation in both EV and Hybrid technical routes. We believe the subsidy retreat happening now will lead to NEV sector consolidation and will radically change the over-supply condition. We believe BYD not only has adequate demand to survive this winter but also has the capability/capacity to become a major supplier for other NEV OEMs when this consolidation phase passes.

### ■ Reorganizing the internal supply chain

**The Company initially adopted a vertical integration model in its NEV supply chain which internalized all production nodes in auto production (model design, mold development, key parts design and manufacturing, assembly, quality control, sales channel management, etc.).** The vertical management model enables the Company to accomplish technology accumulation in all production aspects. However, it also induces higher management costs/production cost.

From 2017, BYD gradually opened up its supply chain. From the perspective of the supply side, purchasing parts/components from the outside vendor can improve the quality of parts, reduce procurement costs and management costs. From the perspective of the demand side, the Company can monetize its advantages in parts/components (power batteries, IGBT, etc) to foster new income sources and improve the performance of the automotive sector.

**Figure 53: Open up the supply chain**



Source: CMBIS

### ■ “FinDreams”

**On 16 Mar 2020, BYD announced the establishment of five subsidiary companies collectively known as “FinDreams (FinDreams Battery, FinDreams Vision, FinDreams Technology, FinDreams Power and FinDreams Mould)”.** The FinDreams covers different businesses ranging from power batteries, semiconductors, chassis, and other fields. It marked that BYD's supply chain reform has moved into a new stage. It is also a big step forward for BYD to underpin its e-platform strategy.

We think BYD's value will be highly dependent on its opening supply chain strategy for its NEV parts business. We will focus on two of the key parts, namely the power battery business and the semiconductor business, in our following discussion in this report. We think the future performance of "FinDreams" will be a critical factor for BYD and its valuation.

**Figure 54: "FinDreams"**

Names	Chinese Names	Business
FinDreams Battery	弗迪电池有限公司	Lithium battery, BMS
FinDreams Vision	弗迪视觉有限公司	Automotive lighting and signal system related products
FinDreams Technology	弗迪科技有限公司	Automotive electronics and chassis
FinDreams Power	弗迪动力有限公司	Automotive powertrain
FinDreams Mould	弗迪模具有限公司	Automotive mould

Source: Company data, CMBIS

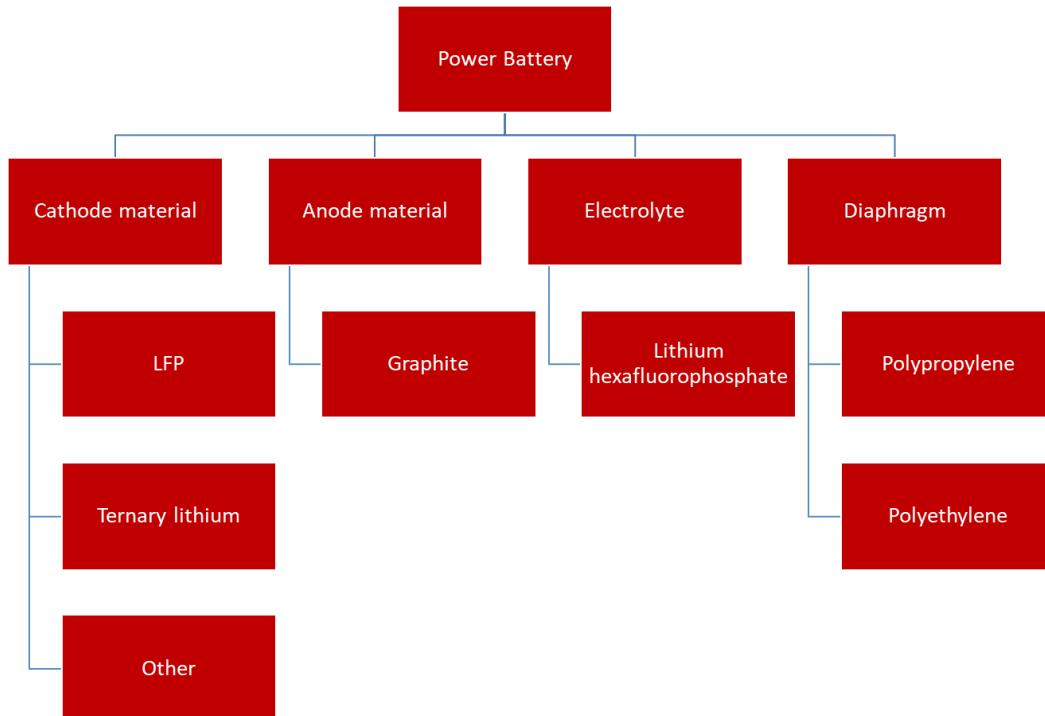
## 1. Power battery

**BYD's power battery was previously used for internal supply only.** However, BYD expressed the intention for external sales given that 1) power battery market has giant demand high growth potential insight, and 2) the Company had accumulated technology advantages in battery cost leadership and safety performance. According to BYD, several OEMs had entered discussions with the Company. After the initial trial phases, we expect BYD power battery to have external shipments from 2021, and to reach high shipment growth in 2022E. We estimate the external shipment of BYD batteries to be 0.1/2.6/18.7GWh in 2020E/21E/22E respectively. The corresponding revenue will reach RMB0.1/2.0/13.7bn in 20E/21E/22E. In 2025E, we forecast BYD will sell 72.0GWh externally with a corresponding revenue of RMB46.1bn.

### ■ Overview in the power battery industry

The power battery value chain can be divided into three sectors: raw materials in upstream, production in midstream, and application in downstream. The power battery system can be simply divided into hardware and software (BMS). The hardware includes a variety of levels in the production-side, namely cell, module, and the final battery pack. The cell can also be further divided into positive and negative electrodes, electrolytes, and separators. These are derived from the raw materials, which are upstream of the whole value chain.

The upstream of power batteries is mainly dominated by mineral resources such as cobalt, manganese, nickel, and lithium. Cobalt, manganese, nickel, lithium, and other raw materials are used as positive electrode materials. Lithium ore is also used for both negative electrode and electrolyte. Graphite is mainly used for the negative electrode. The midstream includes the manufacture of the positive electrode, negative electrode, electrolyte, and separator. The downstream of power batteries are mainly OEMs and energy storage sectors.

**Figure 55: Power battery value-chain**

Source: CMBIS

### ■ Power battery type

Power batteries can be mainly classified into two categories, LFP(LiFePO<sub>4</sub>) batteries and ternary lithium batteries (including nickel cobalt manganese (NCM), nickel cobalt aluminum (NCA)). Other types such as lithium manganese battery, lithium titanate battery, super capacitor, have a relatively small proportion. One form of power battery, namely solid-state battery, may potentially destruct the current landscape. However, we believe that the technology of solid-state batteries was immature. It is expected to achieve full commercialization around 2030E. Therefore, we still focus on LFP and ternary lithium batteries.

In general, LFP has the characteristics of good safety and low cost while the ternary battery has a longer mile range given higher energy density. Due to the difference in application scenarios, about 93% of BEV buses were equipped with LFP while about 74% of BEV PV were installed with ternary lithium batteries.

**Figure 56: Comparison between major battery type**

Battery type	Advantages	Disadvantages
LFP	Good safety and low cost	Low energy density and inferior performance in low temperature
Ternary lithium	High energy density	High price and thermal instability

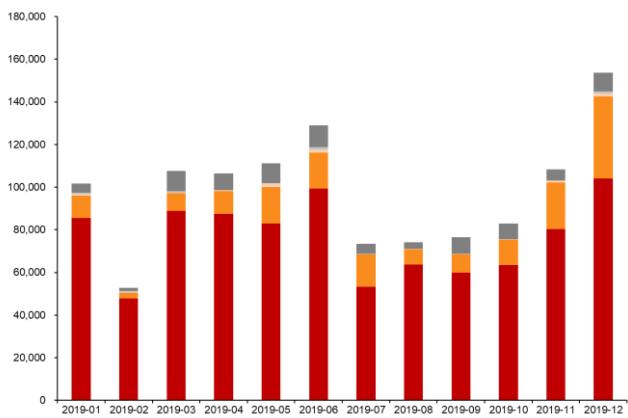
Source: CMBIS

According to GII, in 2019, the total NEV that installed with power battery in China was 1.18mn units, a decrease of 4%YoY. Among them, 916K of which were installed

with ternary batteries, accounting for 78% of total NEV; LFP was installed on 169K vehicles, accounting for 14%.

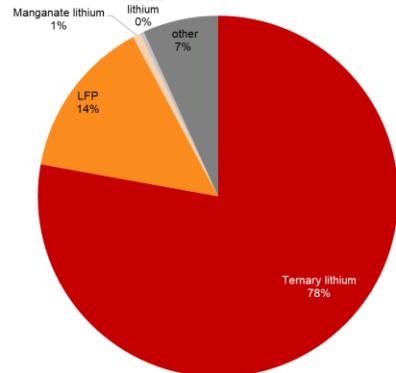
**Figure 57: Monthly installed units by battery type in 2019**

■ Ternary lithium ■ LFP ■ Manganese lithium ■ Titanate lithium ■ other



Source: GGII, CMBIS

**Figure 58: Installed units by battery type in 2019**

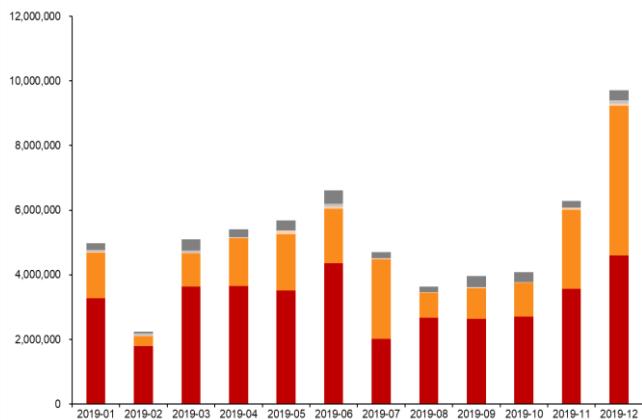


Source: GGII, CMBIS

According to GGII, in 2019, the total installed capacity power battery was 62.3GWh an increase of 9%YoY. Among them, the installed capacity of ternary batteries was 38.4GWh, accounting for 61% of the total installed; the installed capacity of LFP was 20.0GWh, accounting for 32%.

**Figure 59: Monthly installed capacity by battery type in 2019**

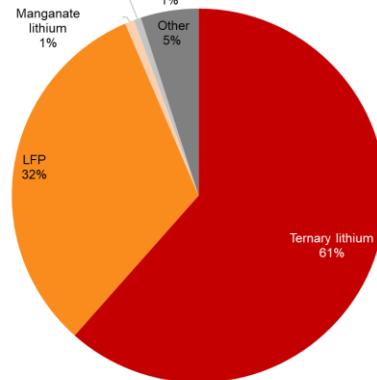
■ Ternary lithium ■ LFP ■ Manganese lithium ■ Titanate lithium ■ Other



Source: GGII, CMBIS

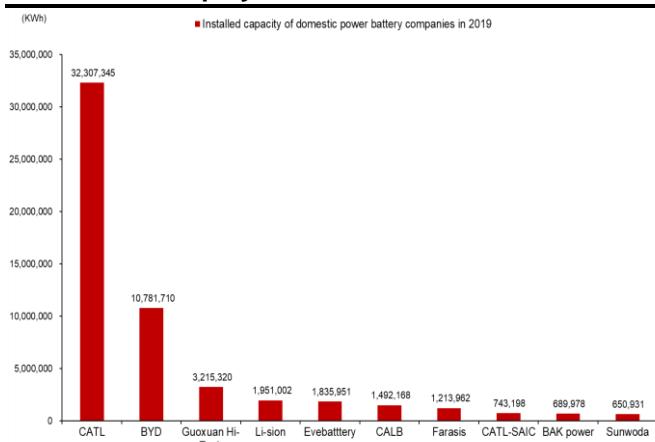
**Figure 60: Installed capacity by battery type in 2019**

■ Ternary lithium ■ LFP ■ Manganese lithium ■ Titanate lithium ■ Other

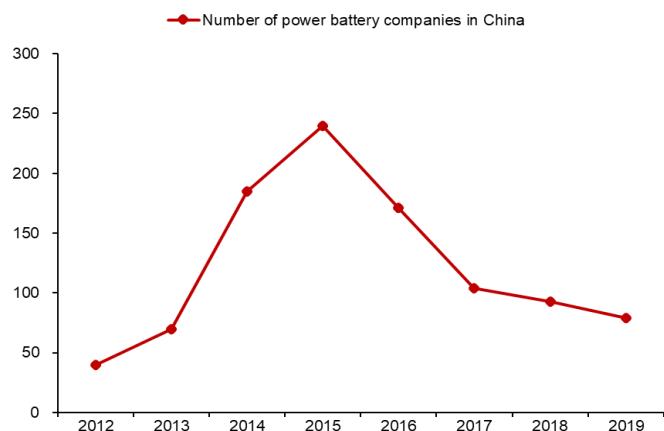


Source: GGII, CMBIS

In the early stage of NEV development, the Chinese government adopted a whitelist for power battery to foster the local industry. OEMs could receive financial subsidy only if its power battery suppliers were admitted into the official power battery whitelist. A total of 57 battery companies have been admitted to the list including CATL, Guoxuan Hi-Tech, Lision, Optimum whereas foreign brands such as Samsung SDI, LG, Panasonic were all excluded from the list. In Jun 2019, MIIT officially abolished whitelist marking the inception of the new competition stage. The domestic power battery player will, therefore, face fiercer competition from overseas giants such as LG and Samsung SDI.

**Figure 61: Installed capacity ranking in 2019: domestic player**


Source: APBIIA, CMBIS

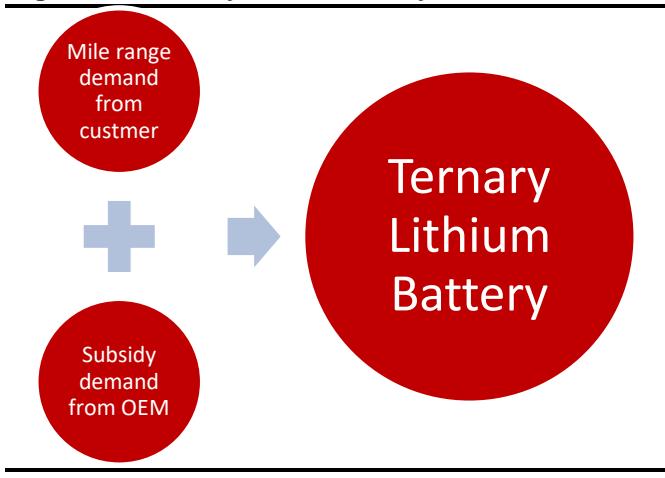
**Figure 62: Number of power battery companies in China**


Source: GGII, APBIIA, CMBIS

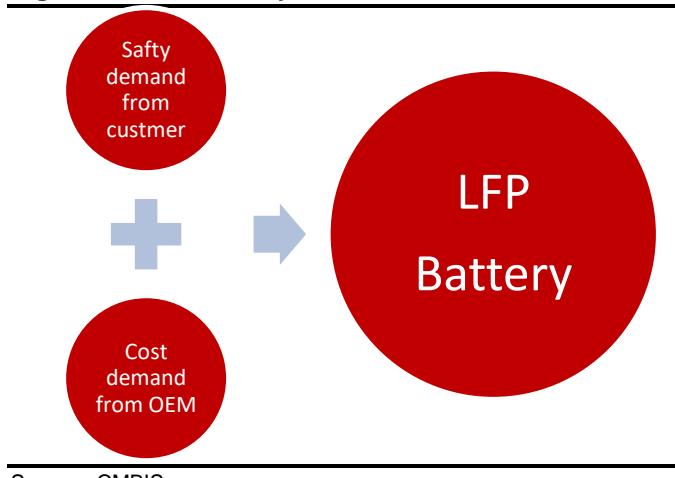
**At the end of 2019, we can simply divide the power battery manufacturing enterprises into three echelons.** The first echelon includes CATL, Panasonic, BYD, LG, Samsung SDI. The second consists of Farasis, Evebattery, Lision, Guoxuan Hi-tech, etc. The third echelon comprises other small manufacturing enterprises. We calculated that CR3 in the power battery industry reached 57%; CR5 reached 68%; CR10 reached 81% in 2019. Since 2015, the number of power battery companies has gradually decreased which reflecting the intensification of market competition. We expect that under the pressure of cost reduction, top tiers will continue to gain market shares which makes the industry further integrated.

### ■ Technical roadmap

**We believe the economies of scale will outweigh the technology process in the process of cost reduction.** There is a dispute about the technical route in the field of power batteries.

**Figure 63: Ternary lithium battery**


Source: CMBIS

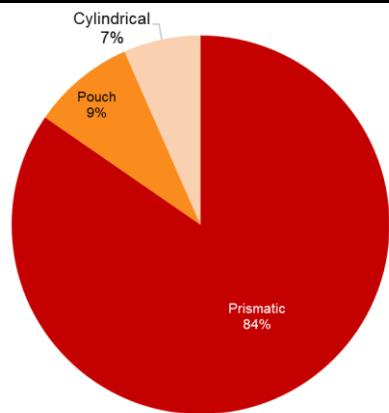
**Figure 64: LFP battery**


Source: CMBIS

**Figure 65: Element function in ternary lithium battery**

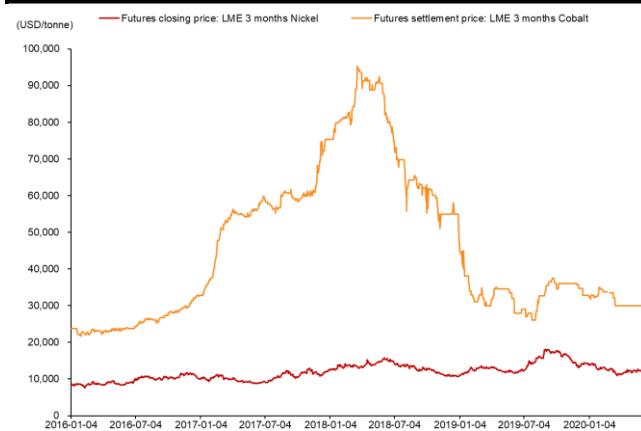
Chemical element	Function
Nickel	Improve mile range
Cobalt	High discharge rate
Manganese	Improve safety

Source: CMBIS

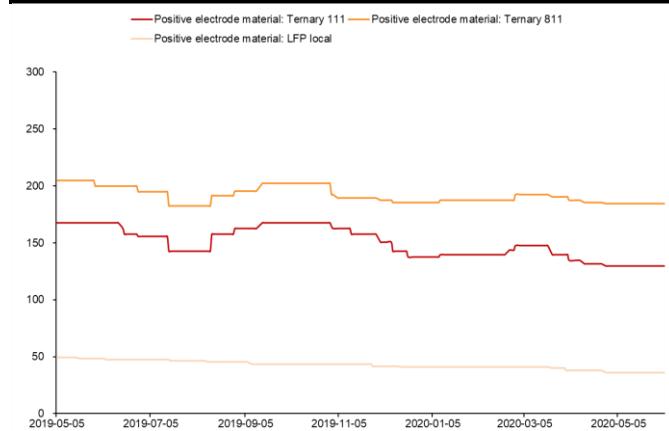
**Figure 66: China Power battery in 2019 by shape**

Source: GGII, CMBIS

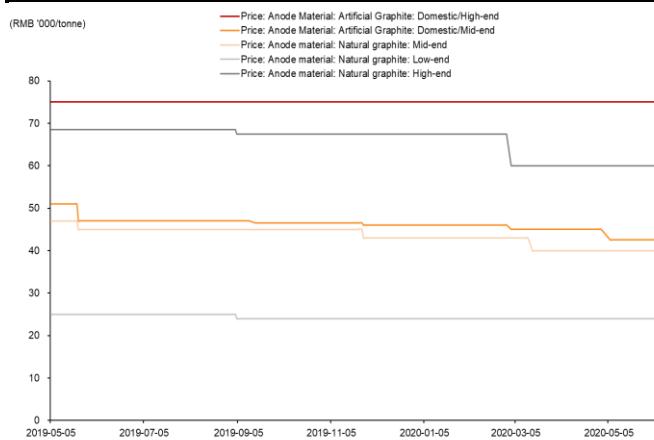
In the ternary lithium battery technical route, the development direction is determined to be high nickel, which mainly solves the problem of mile range. At the same time, due to the scarcity and monopoly of cobalt resources, high nickel also minimizes the supply chain risk. The 811 monomer energy density can reach 280Wh/kg. According to SMM, NCM811 ternary precursor is still 29% more expensive than NCM523 ternary precursor.

**Figure 67: Price: Cobalt vs Nickel**

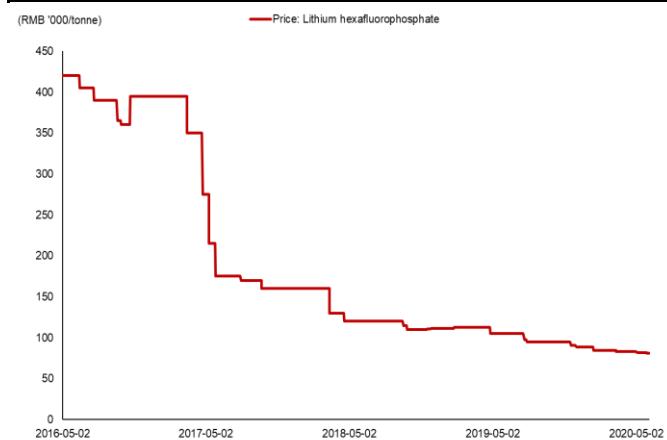
Source: LME, CMBIS

**Figure 68: Price: Positive electrode material**

Source: Wind, CMBIS

**Figure 69: Price: Anode material**

Source: LME, CMBIS

**Figure 70: Price: Lithium hexafluorophosphate**

Source: Wind, CMBIS

**Figure 71: Ternary lithium battery in Jun 2020**

Ternary precursor	Price(RMB K/tonne)
NCM523	72
NCM622	80
NCM811	93

Source: SMM, CMBIS

### ■ BYD will change the game - Blade battery

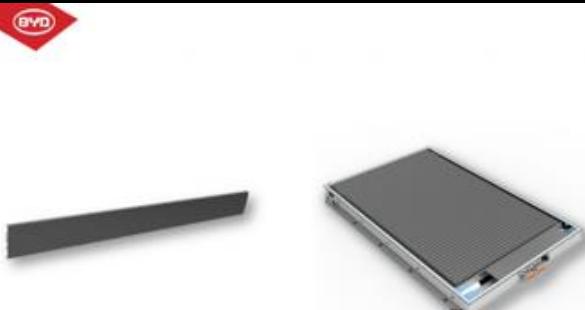
However, **BYD chose to focus on LFP battery development**. BYD has consistently optimized the physical structure of the LFP battery in order to improve its mile range by increasing the system energy density.

In 2019, BYD has deployed NCM on all PVs while used LFP on all CVs. **The situation has changed recently as BYD released its blade battery on 29 Mar 2020**. As one of LFP batteries, the most important achievement of blade battery is that it improves the overall energy density of the battery pack through process improvements, thereby overcoming the disadvantage of short-range of LFP compared to NCM. In the meanwhile, it kept the advantage of high safety and long lifespan of traditional LFP. In the nail penetration test, the ternary battery can only achieve safety at the pack level, while the blade battery can elevate it to the cell level. At the same time, the blade battery can make the new car NEDC last more than 600 kilometers. It will be first used in Han EV in 3Q20E and then subsequently equipped on Qin Pro, Qin EV, Song Plus, etc. in 4Q20E.

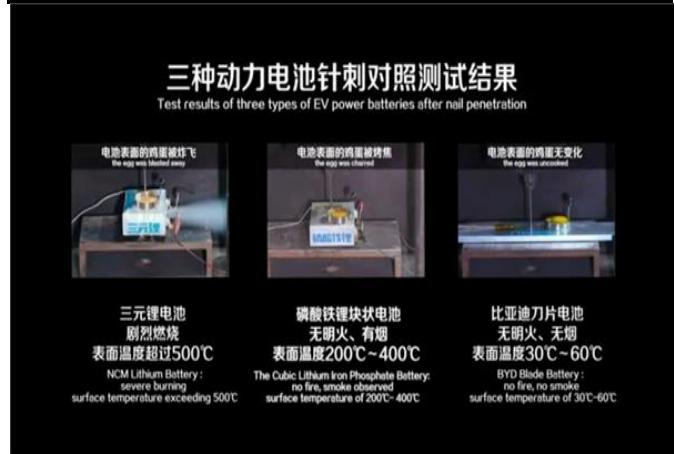
**Figure 72: Physical structure improvement**

Source: Company data, CMBIS

**In terms of cost, the blade battery was 20-30% lower than the main-stream NCM811 at the pack level.** In addition, luxury brands may focus more on safety as reputation risk were greater than new entries. Such a significant cost advantage will provide great competitive advantage overall in NCM. We believe power mass density/volume density will increase further as BYD is in the process of R&D in the second generation of blade battery.

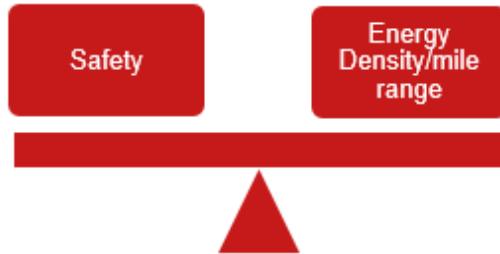
**Figure 73: Blade battery**

Source: Company data, CMBIS

**Figure 74: Blade battery test results**

Source: Company data, CMBIS

**We believe the release of its blade battery will totally change the competitive landscape.** While maintaining its safety nature of LFP, it has increased the mile range. As a result, the blade battery broadens the application scenarios of LFP battery, enabling it to be assembled in A to C-class NEVs. In the meanwhile, due to the nature of the ternary lithium battery, the risk of thermal runaway when facing the acupuncture experiment is higher than that of the LFP battery. We expect that BYD will focus on "safety" in the marketing of blade battery so as to gain more market share in this sub-segment. Given diverse demand from customers, blade battery will definitely fit in certain safety demands and will gain more market shares. In other words, ternary lithium batteries will face competition from its opponent.

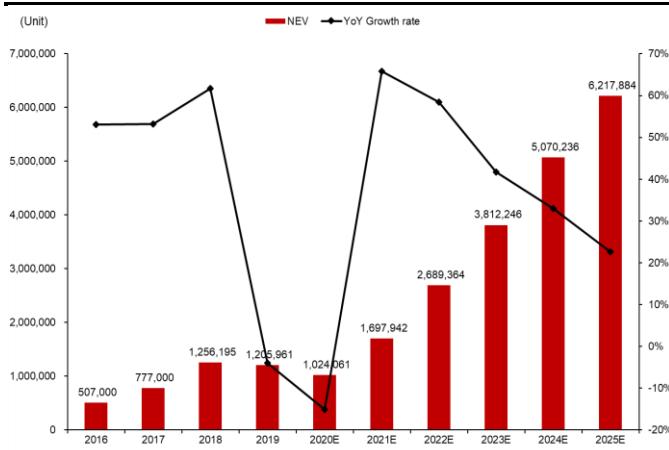
**Figure 75: Trade-off between mile range and safety**


Source: CMBIS

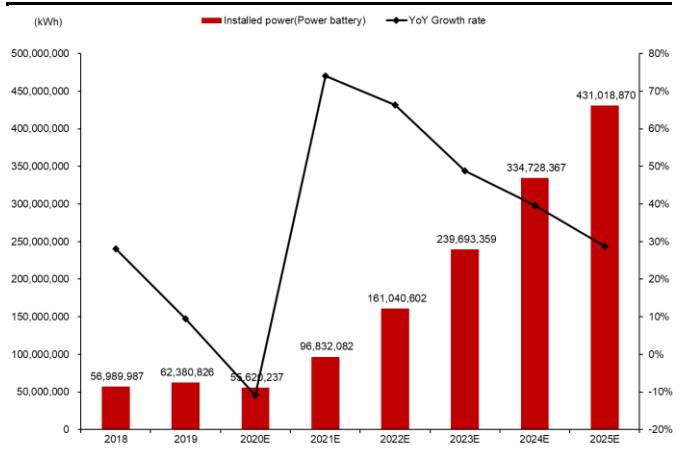
### ■ Total power battery market size in China

According to the GII, the total installed capacity of power batteries in China was 62.8GWh in 2019. CATL was the dominant player in the power battery industry with a market share of 51.8%. BYD was the 2nd largest player with a market share of 17.3%.

According to the CMBIS estimate, we forecast that the total installed capacity of power batteries in China will be 55.6Gwh in 2020E, a decline of 10.8%YoY due to COVID-19 impacts. **However, given CMBIS forecast on China's NEV industry through 2025E, we are confident that power battery installation will rebound back to its high growth path in 2021E as NEV sales normalize to its high growth trajectory.**

**Figure 76: NEV sales forecast in China**


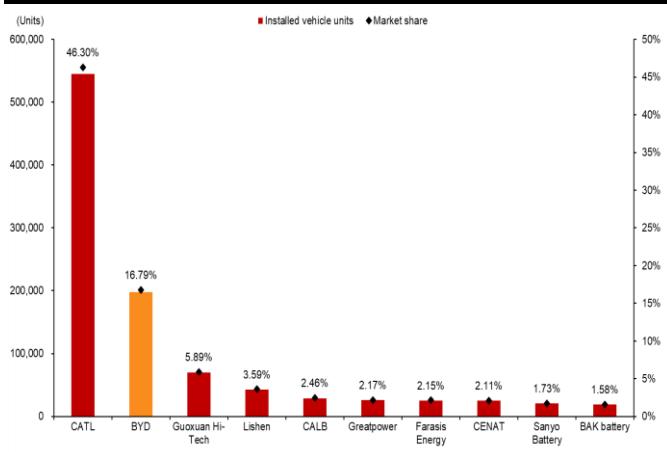
Source: CAAM, CMBIS estimate

**Figure 77: Installed power in China**


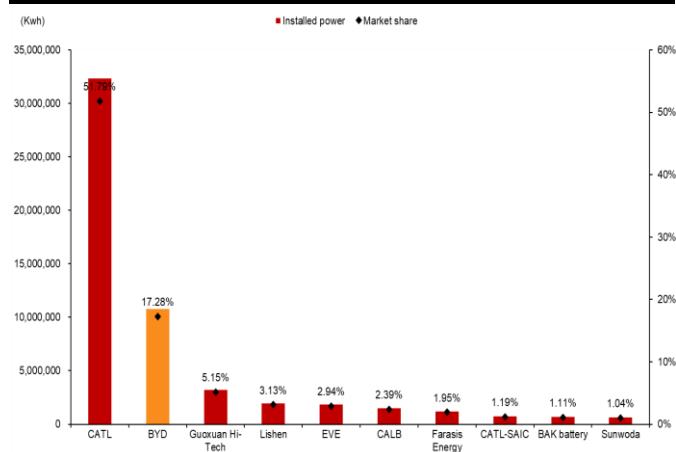
Source: GII, CMBIS estimate

### ■ Sales forecast

**BYD has accumulated the technical advantage and production capacity as it originated from the battery business.** According to GII, in 2019, the Company's installed capacity was 197.6K units, with a market share of 16.8%; the installed power is 10.78GWh, with a market share of 17.3%.

**Figure 78: Installed vehicle units/market share in China in 2019**


Source: Company data, CMBIS

**Figure 79: Installed power/market share in China in 2019**


Source: Company data, CMBIS

We expect BYD to have a total production capacity of 50GWh in 2020E, which is fully capable of internal production. Among all production capacity, NCM/LFP/Blade accounts for 30/10/10GW respectively. As of now, BYD has a total production capacity of a blade battery of 10GWh, equivalent to about 180K units of the vehicle. In 2020E, we expect the blade battery will prioritize internal supply as production was still in the ramp-up period. If we take unit installed capacity of 54Wh, we expect a total production capacity of 0.93mn units NEV in 2020E. BYD ranks No.2 in Chinese power battery supplier in terms of total installed capacity with a leading position in battery density and safety aspects. Based on our calculation, BYD has idle capacity for external sales. According to the Company's guidance, we expect the blade battery will be sold to external clients in late 2021E/early 2022E.

**Figure 80: BYD's Power battery production capacity**

Power battery production capacity(GWh)	2019	2020E	2021E	2022E	2023E	2024E	2025E
Qinghai	24	24	24	24	24	24	24
Chongqing		10	20	20	20	20	20
Xi'an			30	30	30	30	30
Changsha			20	20	20	20	20
Guangdong	16	16	16	16	16	16	16
BYD Changan			10	10	10	10	10
Capacity expansion					30	60	120
<b>Total</b>	<b>40</b>	<b>50</b>	<b>120</b>	<b>120</b>	<b>150</b>	<b>180</b>	<b>240</b>

Source: Company data, CMBIS estimate

### ■ Financial forecast

Given current production capacity, we believe its power batteries in 2020E will be mostly installed internally. With the substantial increase in China's NEV sales and capacity release, we expect that the external shipment of power batteries will skyrocket from 2021E/22E. We forecast the external shipment of BYD batteries to be 0.1/2.6/18.7GWh in 2020E/21E/22E respectively. The corresponding revenue will reach RMB 0.1/2.0/13.7bn in 20E/21E/22E.

In addition, the Company has widely exploited in the supply chain upstream of power batteries, including Lithium mine, the positive electrode, separator, electrolyte, etc., which effectively guarantees the cost and the stability of its supply chain. BYD has widely deployed in the upstream supply chain of power batteries, including salt lake lithium mine,

the positive electrode, separator, electrolyte, etc. By doing so, BYD is able to enforce cost control measures while maintaining its supply chain stability. We believe the economies of scale will realize, as the power battery will gradually sell to external customers, which will ultimately reduce the unit cost.

**We expect its power battery segment will get an independent listing on Starboard in 2022E, significantly lifting its segment valuation.**

**Figure 81: BYS's power battery external sales forecast**

(GWh,Unit)	2020E	2021E	2022E	2023E	2024E	2025E
Effective capacity	44.5	74.5	120	129	159	198
Effective capacity utilization	36%	43%	55%	65%	85%	87.0%
Production-sales ratio	64%	65%	75%	80%	85%	85%
Internal installed	10.12	18.24	30.80	44.04	57.79	74.42
External sales(power capacity)	0.13	2.58	18.70	23.04	57.09	72.00
External sales(vehicle units)	2,471	45,272	312,214	366,518	864,694	1,038,735

Source: Company data, CMBIS estimate

**Figure 82: BYS's power battery revenue forecast**

(RMB mn)	2020E	2021E	2022E	2023E	2024E	2025E
Revenue	108.7	1,985.8	13,661.0	15,997.0	37,646.0	46,059.8
COGS	86.92	1,489.38	9,835.92	11,197.91	25,222.83	30,860.08
GP	21.7	496.5	3,825.1	4,799.1	12,423.2	15,199.7
GPM	20%	25%	28%	30%	33%	33%
Expense ratio*	14.00%	16.00%	16.00%	15.00%	15.00%	15.00%
NP	7	179	1,639	2,152	5,621	7,535
NPM	6.0%	9.0%	12.0%	13.5%	14.9%	16.4%
YoY %		2641.5%	817.2%	31.2%	161.2%	34.1%
<b>2021E-2025E CAGR</b>						<b>155%</b>

Source: Company data, CMBIS estimate

\*Expense ratio includes S&A expense, R&D expense and Tax expense

## 2. IGBT module

**BYD's IGBT is used for internal supply only as well.** BYD semiconductor introduced strategic investors and expressed the intention to sell its IGBT module externally.

### ■ Overview in IGBT industry

**IGBT (Insulated Gate Bipolar Transistor 绝缘栅双极型晶体管) is a composite fully controlled voltage-driven power semiconductor device composed of BJT (bipolar transistor) and MOSFET (insulated gate field effect transistor), which combines the advantage of both BJT and MOSFET.** IGBT is known as the "CPU" of power electronic devices.

The power battery is generally stored as direct current and needs to be converted to alternating current in order to drive the motor of EV (mainly classified as Permanent-magnet synchronous motor 永磁同步电机 and AC asynchronous motor 交流异步电机).

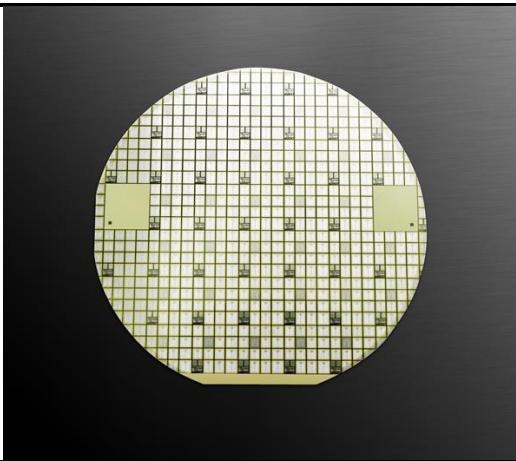
**Figure 83: IGBT chip technology development history**

Generation	Technical characteristics	Chip scale	Saturation voltage drop	Turn-off time (microseconds)	Power loss	Time
1st	Plane penetration type (PT)	100	3	0.5	100	1988
2nd	Improved plane penetration type (PT)	56	2.8	0.3	74	1990
3rd	Trench	40	2	0.25	51	1992
4th	Non-penetrating (NPT)	31	1.5	0.25	39	1997
5th	Field-Stop (FS)	27	1.3	0.18	33	2001
6th	Trench-type Field-Stop (FS-Trench)	24	1	0.15	29	2003

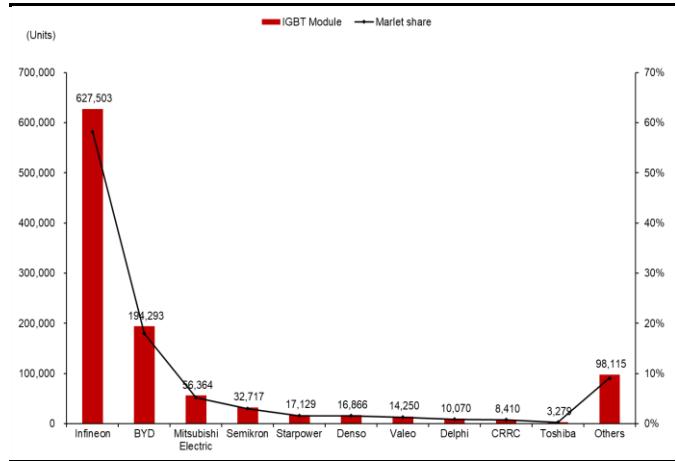
Source: SITRI industry research, CMBIS

**IGBT directly controls the conversion of Direct Current/Alternating Current of the drive system and also determines the maximum torque/maximum output power.** In addition to driving systems, IGBT was used on high-voltage chargers, air-conditioning systems, and other electrical components of NEV.

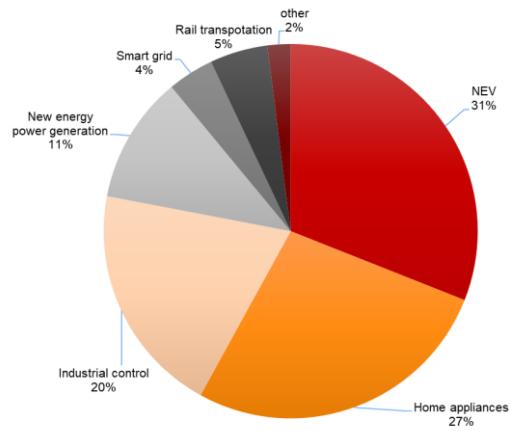
**IGBT chip is one of the critical components for EV engines.** Due to design complexity, sophisticated manufacture requirement, and a large investment, the IGBT sector has a high entry barrier. For EV, the IGBT module accounts for about 50% of the cost of the motor drive system/5%-10% of the total cost of the vehicle. Therefore, it is the 2nd-largest cost component other than the power battery. It also determines the energy efficiency of the vehicle. At present, about 90% of the IGBTs used in China depend on imports, most of which are provided by Infineon, Mitsubishi, Fuji, ON Semiconductor, ABB.

**Figure 84: IGBT 4.0 Wafer**

Source: Company, CMBIS

**Figure 85: IGBT Module sales ranking**

Source: NE, CMBIS

**Figure 86: Applications scenario of IGBT in China**

Source: Intelligence Research Group, CMBIS

**Figure 87: China IGBT market size**

Source: Intelligence Research Group, CMBIS

### ■ BYD's technology advantage and cost advantage

**In 2005, BYD formed its own R&D team and started to invest in the IGBT industry.** As of now, BYD is a top auto OEM in China that has the capability of producing IGBT modules, including IGBT chip design and manufacturing, IGBT module design and manufacturing, QA platform, and NEV application.

**In Dec 2018, BYD launched its IGBT 4.0.** Its comprehensive loss is 20% lower than the mainstream product while the temperature-cycle life is increased by more than 10 times. In terms of cost, BYD has around one-third of cost advantage over a similar product. The downstream application scenario covers A0 to B+ class vehicles while other main players such as StarPower can only apply to A0 class vehicles. At the end of 2018, the yearly production capacity of IGBT units was 600K. As of now, BYD has achieved a production capacity of 1.2mn units per year.

**On 14 Apr 2020, BYD announced that it had completed the internal transfer of its wholly-owned subsidiary Shenzhen BYD Microelectronics Co., Ltd. through the equity transfer and business transfer between its subsidiaries.** Reorganized and officially renamed BYD Semiconductor Co., Ltd. (hereinafter referred to as "BYD Semiconductor"). BYD stated that it intends to introduce strategic investors by means of the capital increase and share expansion, and actively seeks independent listing at an appropriate time. However, after the completion of the introduction of strategic investors, BYD Semiconductor will remain a subsidiary of BYD. At the same time, BYD is actively deploying the next generation of semiconductor material SiC. The Company has announced the successful development of SiC Mosfet, which is expected to improve the performance of the entire vehicle by 10%.

### ■ IGBT Market size forecast

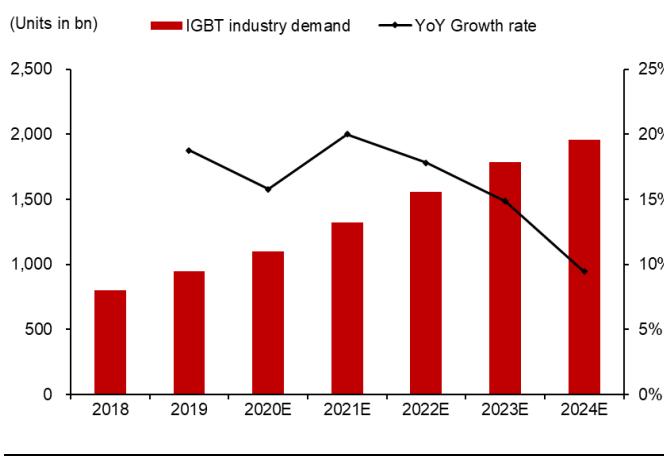
According to "Intelligence Research Group", the global IGBT market size in 2018 was USD5bn, an increase of 11.06%YoY. Of which, China was the world's single largest market and has reached USD2.1bn market size, accounting for about 40% of the global IGBT market.

According to GGII, China's IGBT market will have a market size of RMB20bn in 2020E driven by strong demand for NEV and charging piles. According to "Intelligence Research

Group", China's IGBT industry output will reach 78.2mn units while the demand will reach 196mn units by 2024E.

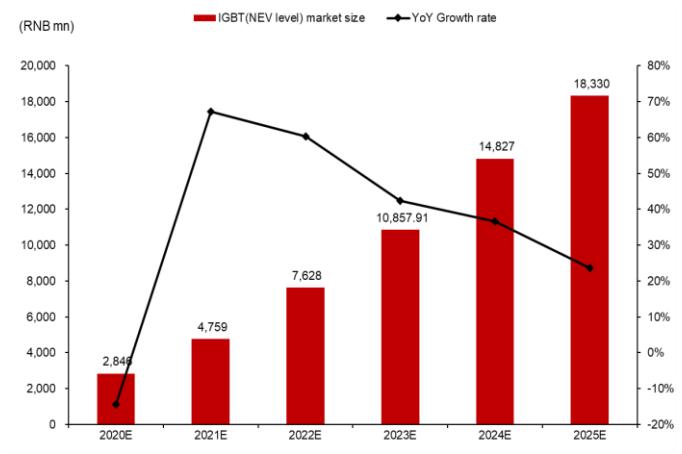
We estimate the total IGBT (NEV level) market size will reach RMB2.8bn in 2020E and RMB18.3bn in 2025E. In 2019, the Company installed about 194K sets of NEV IGBTs domestically, with a market share of 18% and a rank of 2nd place.

**Figure 88: IGBT industry demand in China**



Source: Intelligence Research Group, CMBIS

**Figure 89: IGBT (NEV level) forecast**



Source: CMBIS estimates

## ■ Financial forecast

**Given its cost advantage, we believe BYD will materialize the import substitution in the IGBT module industry.** We expect that the external sales of the IGBT module will start from 2021E/22E. We forecast the external shipment of IGBT to be 133K/274K in 2021E/22E respectively. The overall ASP will increase gradually as the proportion of higher class increases. We forecast the corresponding revenue will reach RMB370/778mn in 2020E/21E.

**We expect a surge in IGBT demand from NEV as NEV cost parity may materialize in 2023E.** Therefore, we believe BYD will expand its IGBT production capacity in order to meet downstream demand. In 2025E, BYD will sell 995K units of IGBT module externally with revenue of RMB2.9bn.

**We expect its power battery segment will get an independent listing on Starboard in 2021E, significantly lifting its segment valuation.**

**Figure 90: BYS's IGBT external sales forecast**

(Vehicle Unit in mn)	2020E	2021E	2022E	2023E	2024E	2025E
Production Capacity	1.20	1.20	1.20	1.20	2.40	2.40
Effective capacity utilization	16%	38%	66%	92%	75%	86%
Internal installed	0.19	0.32	0.51	0.70	0.88	1.07
External sales	0.00	0.132	0.274	0.400	0.915	0.995
Unit price(RMB)	2,779	2,803	2,826	2,848	2,924	2,948
YoY %	0.9%	0.9%	1.2%	0.4%	2.7%	0.8%

Source: Company data, CMBIS estimates

**Figure 91: BYS's IGBT forecast**

(RMB mn)	2020E	2021E	2022E	2023E	2024E	2025E
Revenue	370.1	777.8	1,138.4	2,675.0	2,932.8	
GPM	30%	30%	30%	30%	30%	30%
Exp ratio*	15%	15%	15%	15%	15%	15%
NPM	15%	15%	15%	15%	15%	15%
NP	55.51	116.66	170.76	401.26	439.92	
YoY%		110.2%	46.4%	135.0%	9.6%	
<b>2021E-2025E CAGR</b>						<b>68%</b>

Source: Company data, CMBIS estimate

\*Expense ratio includes S&amp;A expense, R&amp;D expense and Tax expense

### 3. Consumer electronics (Component + Assembly Service)

**BYD operates its consumer electronics segment through its subsidiary BYD Electronics (285 HK).** As one of the world's most comprehensive cell phone components and assembly service providers, BYD provides a one-stop business model, including design, component, and assembly services for domestic and foreign mobile phone manufacturers. Its main customers include Apple, Samsung, Microsoft, Dell, Toshiba, Hewlett-Packard, Huawei, Lenovo, and ZTE.

**In recent years, BYD electronics has grown steadily in terms of revenue.** In 2019, BYD Electronics achieved revenues of RMB53.4bn, an increase of 26.4%YoY. However, due to the slowdown in the smartphone market and the fierce competition, its bottom-line drop to RMB1.65bn, a decline of 28.0% YoY.

**BYD Electronics (285 HK) is covered by the CMBIS TMT team (Alex Ng).**

**Figure 92: PVH Technology**

Source: Company, CMBIS

**Figure 93: 7 Series Aluminium Alloy**

Source: Company, CMBIS

#### ■ Financial forecast

Due to different accounting in Mainland, China, and HKSAR, China, the revenue reported by BYDE (285 HK) and the segment revenue in BYD (1211 HK) have a slight discrepancy. Therefore, we take the growth rate forecast from the CMBIS TMT team as our key assumption to keep the CMBI consistency. **As a result, we believe the top-line for handset components and assembly services will grow at 37.8%/12.8%/22.9% to RMB74/83/102bn in 2020E/21E/22E.**

#### 4. Secondary rechargeable batteries and photovoltaics

In the field of secondary rechargeable batteries, BYD carries layout covering the entire supply chain, from the mineral resources to the final battery packs. It has technical accumulations from battery design to module packing.

BYD's current products include nickel-metal hydride batteries, lithium cobalt oxide batteries, lithium iron phosphate batteries, ternary batteries, which are widely used in electronic products, NEV, Energy storage, and other fields.

Through its rechargeable product, BYD also expands its business to the downstream industry. It has also launched a variety of renewable energy solutions such as solar power stations, energy storage power stations, electric forklifts, etc., providing a complete set of renewable energy solutions from power generation to energy storage/consumption.

In 2019, the secondary rechargeable batteries and photovoltaics achieved revenue of RMB10.5bn, an increase of 17.4%YoY. In 2020E, we expect this segment to maintain its steady growth path.

**Figure 94: Project type**



Source: Company, CMBIS

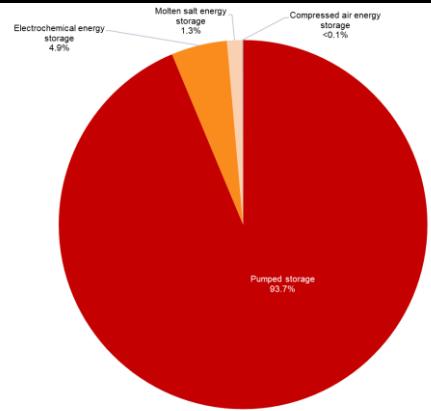
**Figure 95: Project case study**



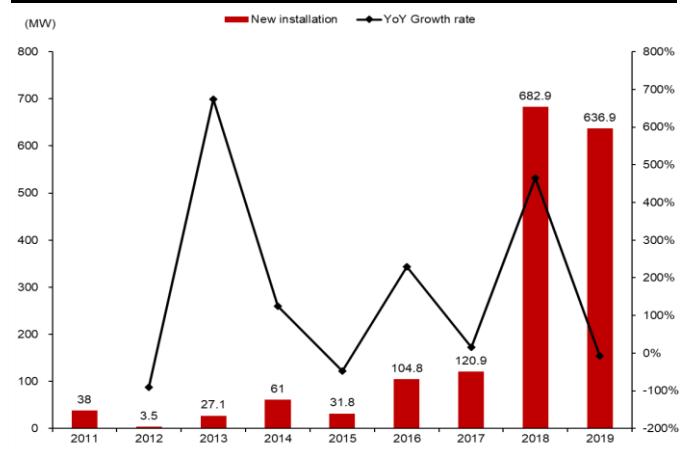
Source: Company, CMBIS

#### ■ Financial forecast

According to CNESA, at the worst-case scenario, electrochemical energy storage will have a total install capacity of 2,727MW in 2020E, an increase of 59.7%YoY; at the best-case scenario, electrochemical energy storage will have a total install capacity of 3,092MW in 2020E, an increase of 80.9%YoY. Given the continued decline in battery prices and demand from 5G base station construction, we are definitely optimistic about future development of energy storage. **For BYD, we expect the revenue from rechargeable batteries and photovoltaic will be RMB13/14/16bn, an increase of 20%/15%/12% YoY in 2020E.**

**Figure 96: Types of energy storage in China**

Source: CNESA, CMBIS

**Figure 97: Electrochemical energy storage in China**

Source: CNESA, CMBIS

## 5. Other business (Cloud rail/bus)

**In Oct 2016, BYD released its first cloud rail prototype.** Compared with traditional subway/underground, cloud rail has advantages such as flexible route layout, low construction cost, etc. At the end of 2019, many domestic cities include Yinchuan, Jining, Bengbu, have expressed interest in Cloud rail while many foreign cities such as Salvador(Brazil) also signed a construction contract with BYD. In 2019, other business achieved revenues of RMB587mn, a decline of 79.5%YoY.

**In 2020E, we believe the cloud rail business may surprise the market as two projects (Shenzhen and Chongqing) was in great progress.** We expect the market will have a potential re-rating on its cloud rail segment as income gradually realizes.

**Figure 98: Rendering – Cloud rail**

Source: Company, CMBIS

**Figure 99: First Cloud rail project - Yingchuan**

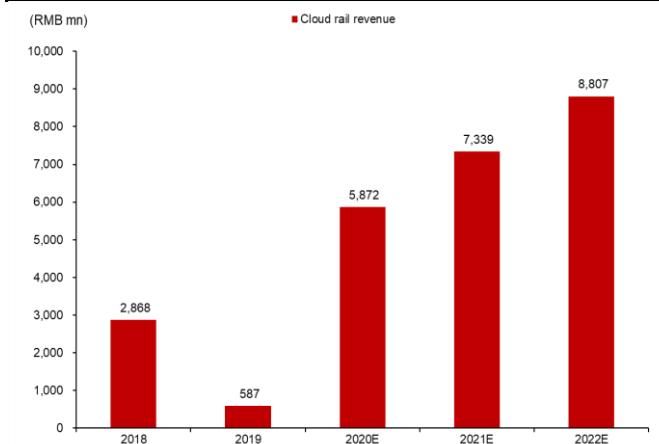
Source: Company, CMBIS

## ■ Financial forecast

We only take cloud rail/bus as other businesses here. Given a more friendly policy environment, we believe the cloud rail business may outperform its historical path. In addition, we believe the fiscal policy will play a critical role in counter-cyclical adjustment due to the negative impact of COVID-19 in 2020E. Therefore, we believe the local government may expand its investment in urban transportation. Given the positive progress in Shenzhen and Chongqing projects and the company's guidance, we forecast that

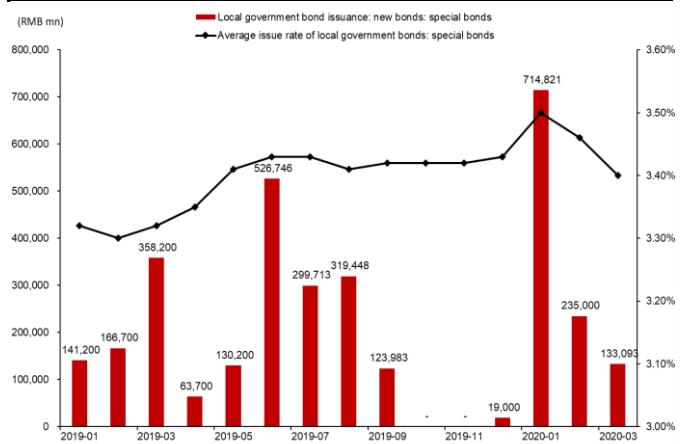
revenue from the cloud rail business will be RMB5.9/7.3/8.8bn in 2020E/21E/22E, a 900.0%/25%/20%YoY increase.

**Figure 100: Cloud rail revenue forecast**



Source: Company date, CMBIS estimate

**Figure 101: Local government bond: special bond**



Source: MOF, CMBIS

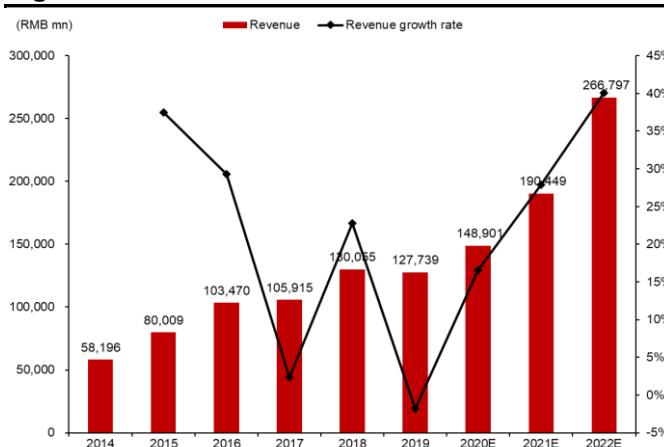
## Financial Analysis

### ■ Revenue

The Company generates revenue through Automobiles and Related Products, Handset Components and Assembly Services, Rechargeable Batteries and Photovoltaic, and Other business. In 2019, revenue from auto and related products decreased by 16.8% YoY to RMB 63.3bn, whereas revenue from handset components and assembly services increased 26.4% YoY to RMB53.4bn. In 2019, revenue from rechargeable batteries and photovoltaic increased 17.4% YoY to RMB10.5bn, whereas revenue from other businesses decreased by 79.5% YoY to RMB587mn.

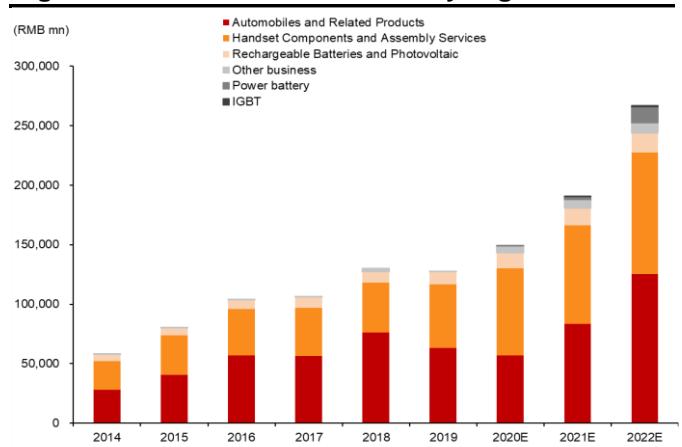
By summing up above each segment, we estimate the revenue for BYD will be RMB149bn/190bn/267bn, an increase of 17%/28%/40% in 2020E/21E/22E.

**Figure 102: Revenue forecast**



Source: Company data, CMBIS estimates

**Figure 103: Revenue breakdown by segment**

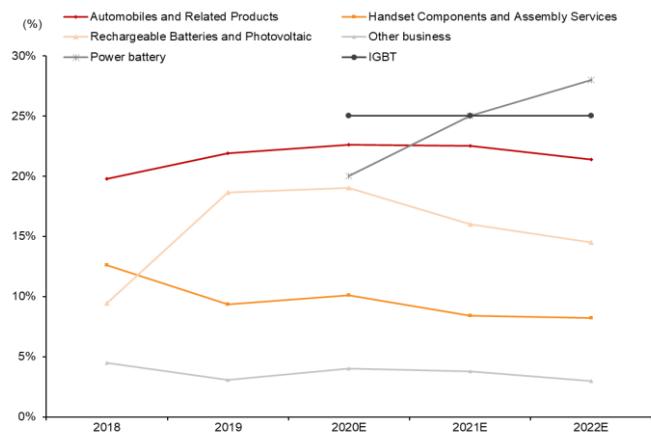


Source: Company data, CMBIS estimates

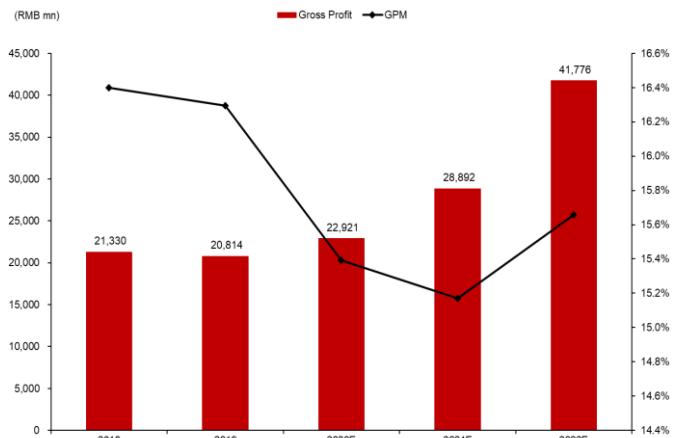
### ■ Gross profit/Net profit(overall)

We believe four factors may put auto segment GPM into pressure in 1H20E given 1) BYD has rolled e series which focus on the mass market; 2) great competition in overall NEV market; 3) subsidy retreat; 4) COVID-19 impact. However, we still believe the GPM for NEV in 2020E will exceed that of 2019E given 1) marginal YoY improvement in NEV industry and 2) local subsidy support (i.e. Shenzhen). Therefore, we believe GPM from the auto segment will slightly rise by 0.7ppt to 22.6% in 2020E. We take the GPM forecast for Handset Components and Assembly Services from CMBI TMT. Specifically, we believe GPM for this segment will be 10.1% in 2020E. We believe rechargeable batteries and photovoltaic will keep its growth momentum with a GPM of 19.0% in 2020E. We believe the GPM from the cloud rail business will rebound to 4.0% in 2020E. In aggregate, we estimate the GPM for BYD will achieve 15.4% in 2020E.

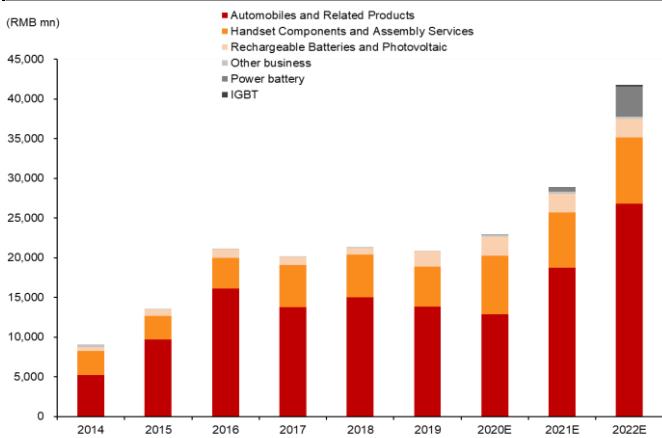
Even though GPM for auto segment/HCAS will face downward pressure, we believe GPM will keep at 15.2%/15.7% in 2021E/22E as power battery/IGBT has a higher margin compared with other segments.

**Figure 104: GPM forecast by segment**

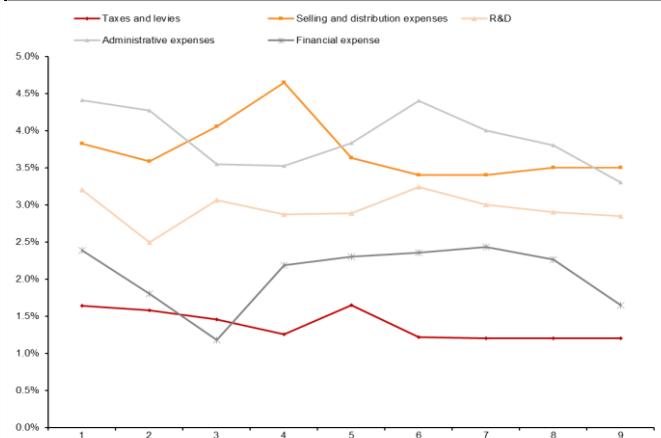
Source: Company data, CMBIS estimates

**Figure 105: GP/GPM**

Source: Company data, CMBIS estimates

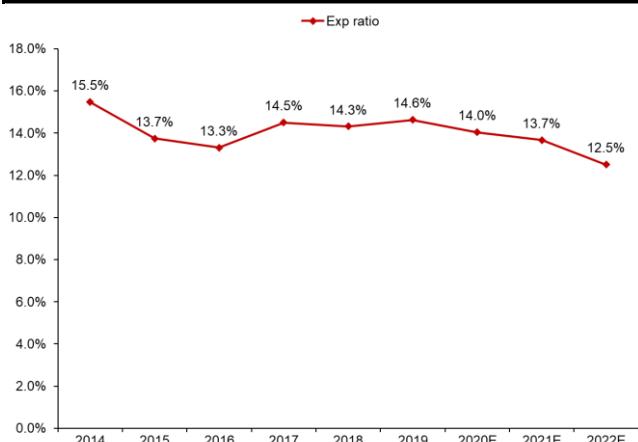
**Figure 106: GP breakdown by segments**

Source: Company data, CMBIS estimates

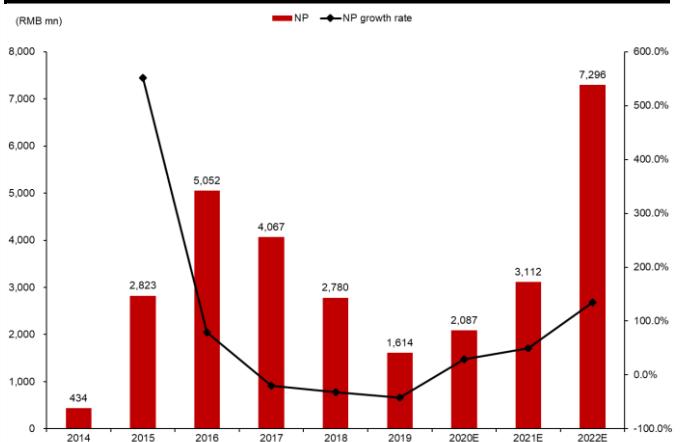
**Figure 107: Expense ratio breakdown**

Source: Company data, CMBIS estimates

We expect a downward trend in expense ratio as the spin-off of its business segments should increase overall operating efficiency. The derived NP will be RMB2.0bn/3.1bn/7.3bn in 2020E/21E/22E, an increase of 29%/49%/134% respectively.

**Figure 108: Expense ratio**

Source: Company data, CMBIS estimates

**Figure 109: NP/YoY Growth rate**

Source: Company data, CMBIS estimates

## Valuation

### Initiate BUY with TP HK\$100.00(25.8% upside)

We adopt the SOTP method to evaluate BYD's value. We derive BYD's overall value of RMB359.9bn in 2021E, mainly comprised of 37% of Auto and related product sales and 45% of the newly emerging Power Battery business. We apply a 32% conglomerate discount to reflect the complexity of BYD's business segments. **Our TP for BYD-H is HK\$100.00 per share, implying a 25.8% upside. We initiate BYD-H with BUY recommendation.**

For short-term to medium term, we think BYD's valuation will be sensitive to 1) monthly sales figure release of new car model; 2) power battery and IGBT's progress on the external shipment in 2021-22E; and 3) progress of potential spin-off of power battery and IGBT business in the A-share market.

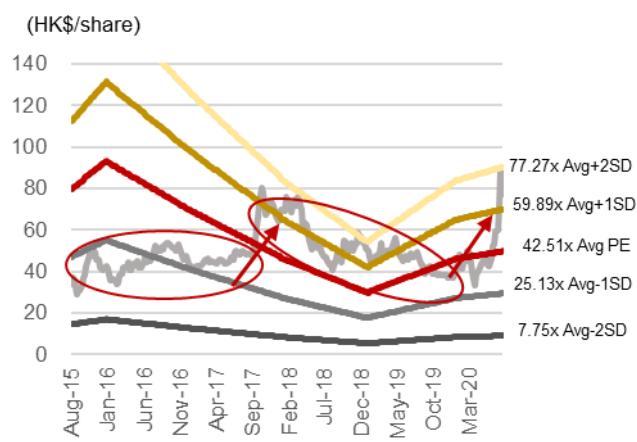
### Valuation is experiencing re-rating

Looking back at BYD-H's share price history in the past five years, a forward PER valuation was ranged between 15.0x and 78.5x with an average of 42.0x; forward PBR valuation was ranged between 1.4x and 3.7x with an average of 2.2x.

BYD's valuation exhibited quite significant policy sensitivity. We observed obvious re-rating from Jul 2017, as BYD-H was traded up 1 level, from -1 STD to +1 STD, driven by 1) Chinese government's establishment of long-term NEV promotion mechanism through releasing policy draft of the double credit system; and 2) BYD was launching new flagship MPV car called Song Max. We think the market's recognition of NEV's long-term high growth potential and BYD's new EV model's competitiveness had triggered the re-rating.

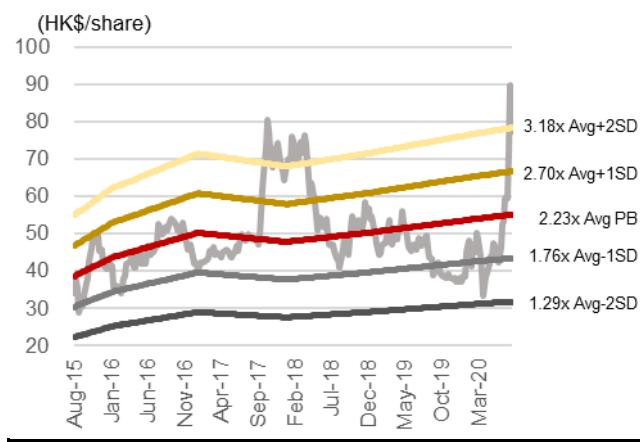
From Jun 2020, we think BYD is experiencing another re-rating process, on the back of 1) Chinese government's revised double credit policy and target enforcement of the policy from 2021; 2) NEV purchase subsidy to sustain with a step-down scheme until end-2022; 3) BYD launching new Han series car model and blade battery; and more importantly 4) opening up supply chain strategy release value of power battery and IGBT business. Although share price has experienced a significant rebound of 137.6% from a year low in Mar 2020, we believe the re-rating process is not yet finished, and we think our rigorous valuation model supports our view.

**Figure 110: BYD-H's 5-Yr PE band exhibited a significant path of re-rating since 3Q17**



Source: Bloomberg, CMBIS

**Figure 111: BYD-H's 5-Yr PB band**



Source: Bloomberg, CMBIS

## Our valuation for BYD points at RMB305.9bn

We adopt the SOTP method to evaluate BYD's value, given the Company's diverse business segments. We also divide BYD's business segments into two groups, namely

- **the tangible group** generating revenue and earnings from external customers with the mature business model including 1) Auto, b) Handset Components and Assembly services, and 3) Rechargeable Batteries and Photovoltaic; and
- **the intangible group** containing auto supply chain open up and emerging business including 1) Power Battery, 2) IGBT, and BYD's emerging 3) Cloud Rail business.

We estimate the tangible group worth RMB170bn or RMB62.30 per share in FY21E, comprised of RMB133bn from ICE and NEV auto sales, RMB12.3bn from rechargeable batteries and photovoltaic business, and RMB24.7bn for HCAS business based on BYD's holdings on BYD Electronics (BYDE, 285 HK). Our tangible segment valuations are based on market P/S comparable, and our in-house TMT team's valuation on BYDE ([link](#)).

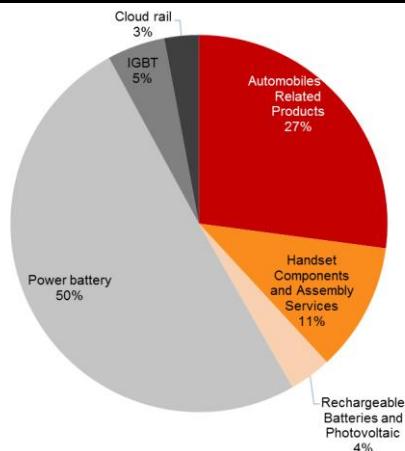
We believe BYD's market value will be highly dependent on the intangible and emerging business, especially from the power battery segment. We estimate the overall intangible group worth RMB189.9bn or RMB69.6 per share in 2021E, leading by the power battery segment with a valuation of RMB162.8bn or RMB59.69 per share. We have listed our valuation details for power battery, IGBT, and cloud rail in our following discussions.

**Figure 112: 2021E SOTP valuation summary**

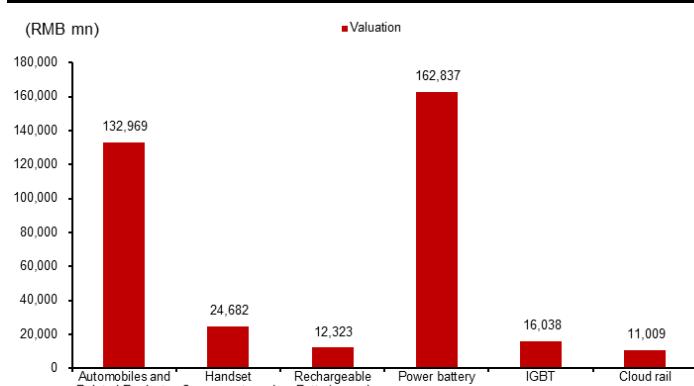
Business segment	Valuation method	Valuation multiple	2021E Valuation (RMB mn)	Implied share price (RMB)
<b>Automobiles and Related Products</b>			132,969	48.74
Traditional fuel vehicles	PS	0.5	11,199	4.10
NEV	PS	2	121,770	44.63
<b>Handset Components and Assembly Services*</b>	PE	12	24,682	9.05
<b>Rechargeable Batteries and Photovoltaic</b>	PS	0.85	12,323	4.52
<b>Power battery</b>	2025E/PE	30	162,837	59.69
<b>IGBT</b>	2025E/PE	35	16,038	5.88
<b>Cloud rail</b>	PS	1.5	11,009	4.04
<b>Total valuation</b>			359,859	131.91
<b>Valuation @ conglomerate discount</b>		0.85	305,880	112.12
<b>A Share price(RMB)</b>				112.12
<b>AH discount(multiply)</b>		0.8		
<b>FX</b>		0.897		
<b>H Share price(HKD)</b>				100.00

Source: CMBI estimates

\*Valuation taken from CMBI TMT team

**Figure 113: Valuation proportion in 2021E**

Source: CMBIS estimates

**Figure 114: Valuation by segment in 2021E**

Source: CMBIS estimates

## Power Battery

Since BYD just opened up its power battery supply chain to external customers, there is no clear earnings data to support the valuation. We project BYD power battery's long term growth path based on the assumptions that the Company will gain NEV installation market shares in China, and we project BYD's power battery net profit margin rate with reference to CATL (300750 CH), a pure-play market leader of the power battery business. In 2025E, we estimate the BYD power battery to seize 34.0% market share in China, shipping 72GWh to external customers, realizing revenue and net profit of RMB46bn/RMB7.5bn respectively.

We expect high shipment growth to continue, as our model implying only 9.0% of global NEV penetration rate measure by vehicle sales in 2025. We apply 30x PER (based on 1X PEG) on 2025E earnings and discount back to 2021 based on 8.5% WACC to derive a 2021E power battery valuation of RMB162.8bn. With reference to CATL's market value of RMB457bn and consensus estimates of 94x FY20E PER with earnings CAGR of 22.6% in 2019-22E, we think our valuation for BYD power battery is justified. BYD plans to take the power battery business public by 2022E, by then we think the segment's value can be fully released.

**Figure 115: Our estimate of BYD's WACC**

### WACC Calculations

Cost of debt	4.5%
Tax rate	20%
After tax cost of debt	3.6%
Adjusted beta	1.06
Market risk premium	11.07%
Risk free rate	1.8%
Cost of equity	13.5%
% of debt financing	50%
WACC	8.5%

Source: CMBIS estimates

**Figure 116: our valuation for BYD power battery worth RMB162.8bn in 2021E**

Power battery	2020E	2021E	2022E	2023E	2024E	2025E
Key assumptions						
Effective Capacity - GWh	44.5	74.5	120	129	159	198
Effective capacity utilization rate-%	36%	43%	55%	65%	85%	87%
External shipment - GWh	0.13	2.58	18.70	23.04	57.09	72.00
EV installation - unit	2,471	45,272	312,214	366,518	864,694	1,038,735
China EV battery market shares-%	18.4%	21.5%	30.7%	28.0%	34.3%	34.0%
Global EV battery market shares-%	10.2%	14.9%	25.4%	24.8%	30.5%	28.0%
ASP, VAT excl. - RMB/Wh	810	769	731	694	659	640
Sales revenue - RMB mn	109	1,986	13,661	15,997	37,646	46,060
Net margin %	6.0%	9.0%	12.0%	13.5%	14.9%	16.4%
Net income - RMB mn	7	179	1,639	2,152	5,621	7,535
YoY %	n/a	2642%	817%	31%	161%	34%
PE multiple - 2025						30
Discounted segment value - RMB mn						226,062
Discount back to 2021E		162,837				

Source: CMBIS estimates

## IGBT

Same as a power battery, BYD's IGBT business provides no clear figure to support the valuation. We also project IGBT's expansion and external shipment path till 2025E, based on several key assumptions including capacity addition, utilization rate, increasing ASP trend as NEV sales shift towards high-end models as well as net profit margin. Our net profit margin is set based on StarPower (603290 CH), a pure-play IGBT module manufacturer just entering the NEV IGBT market. In 2025E, we estimate BYD IGBT to seize 33.3% market share in China, shipping 1.07mn sets to domestic car installation, realizing revenue and net profit of RMB2.93bn/RMB880mn respectively.

We apply 35x PER (based on 1X PEG) on 2025E earnings and discount back to 2021 based on 8.5% WACC to derive the 2021E IGBT valuation of RMB22.2bn. Taking 72.3% of the total equity ratio, we estimate that value attributable to BYD will be RMB16.0bn.

StarPower is currently has a market value of RMB38.8bn, trading at FY20E 214x PER with 27.4% earnings CAGR in 2019-22E. Comparing with StarPower, we believe BYD has several advantages: 1) cover all types of vehicle from A0 to B+ class (StarPower can only apply to A0); 2) great tracking record and larger market share in vehicle level IGBT; 3) high growth potential as BYD will expand production capacity. As for a reference, BYD issued an announcement on 15 Jun 2020, that BYD Semiconductor has already accomplished A+ round of financing and introduced a total of 30 strategic investors. After the A+ round of financing, the valuation of BYD Semiconductor has reached RMB10.2bn. The Company plans to take its IGBT business public listing in 2H21E. We think our valuation for BYD's IGBT business is justified, and the potential IPO will further unlock the segment's value.

**Figure 117: our valuation for IGBT worth RMB15.97bn in 2021E**

IGBT business	2020E	2021E	2022E	2023E	2024E	2025E
<b>Key assumptions</b>						
Effective Capacity	100,000	100,000	100,000	100,000	200,000	200,000
Effective capacity utilization rate	1.20 15.5%	1.20 37.7%	1.20 65.7%	1.20 91.7%	2.40 74.6%	2.40 86.2%
Shipment to internal EV usage	0.19	0.32	0.51	0.70	0.88	1.07
Shipment to external EV usage	-	0.13	0.27	0.40	0.91	0.99
China market shares	18.2%	26.6%	29.3%	28.9%	35.3%	33.3%
Unit ASP	2,779	2,803	2,836	2,848	2,924	2,948
Sales revenue	-	370	778	1,138	2,675	2,933
Net margin	0.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Net income	-	111	233	342	803	880
YoY %	n/a	n/a	110%	46%	135%	10%
PE multiple-2025						<b>35</b>
Segment value - RMB mn						<b>30,795</b>
Discount back to 2021E @72.3% equity ratio*		<b>22,182</b>		<b>16,038</b>		

Source: CMBIS estimates

Note: \* BYD had an A+ round equity financing by 15 Jun 2020. After the fund raising, BYD holds 72.3% shares of BYD Semiconductor (i.e. the IGBT business).

## Cloud rail

In Jun 2018, the State Council issued the "Opinions on Further Strengthening the Management of Urban Rail Transit Planning and Construction" 《关于进一步加强城市轨道交通规划建设管理的意见》(国办发〔2018〕52号)(52号文), tightening the application criteria for the construction of urban rail projects. However, we observe recent policy updates indicating policy relaxation in this field. Since 2020, the Chinese government has begun to emphasize new infrastructure. Infrastructure projects in such fields as 5G networks, extra-high-voltage power transmission projects, inter-city transit, vehicle charging stations, big data centers, industrial networks, and projects exhibiting Internet of Things characteristics are all considered to be examples of new infrastructure. Urban rail is the only sub-field included in both new infrastructure and traditional infrastructure.

Given the policy spur and project progress, we forecast that the revenue from Cloud Rail in 2021E will reach RMB7.3bn. We expect the cloud rail will get out of the dull pattern in the past and head to a high growth period in the next few years. We take CRRC (601766 CH, NR) as our valuation reference. The forward average PS ratio of CRRC was 1.35x while we take 1.50x PS for BYD to reflect the high potential growth potential backed by contacts signed. We derive the Cloud Rail segment's valuation of RMB11.0bn in 2021E.

## Other potentials values

Though we have considered major explicit and implicit valuation, we believe BYD still has other potential values that can be unlocked in the future.

**1) Conservative market assumption.** We only consider NEV sales, power battery, IGBT module under the backdrop of China domestic market for now. If BYD starts to expand its business abroad, we think the valuation will have the potential to rise further.

**2) Other hidden business segments.** In addition to explicit and implicit valuation mentioned in our previous discussion, we believe BYD still has additional values that can be potentially realized in the future such as the NEV motor segment, platform technology, etc.

## Risk factors

### Fiercer market competition

At present, the competitive landscape of the NEV is still undergoing dynamic changes. New Comers (NIO, Weltmeister, Xpeng, etc) and foreign brands (Tesla, BBA, etc) are gradually entering into the market. In the future, market competition will definitely intensify. To continue to gain market share, BYD not only has to have the technical advantage as previously mentioned but also form its own marketing strategy and product ecology.

### Slower external shipment process

As we mentioned, BYD's valuation reflects its external shipments of power batteries and IGBT modules. We expect BYD will start selling its NEV parts in 2021E. However, affected by COVID-19, the external supply process may be slower than expected in terms of product certification and business development. It may affect the short-term market sentiment even though the long-term shipment process will stay intact.

### Unexpected technology route change

BYD placed major auto technology focus on BEV and PHEV. The Company is also making considerable investments in LFP based blade power batteries. If FEV or battery technology has a breakthrough and becomes market mainstream, BYD's leading technology reserve and product streams will be flipped, and it will have material impacts on product sales and earnings performance of the Company.

### Policy support is less than expected

NEV sales still heavily rely on purchase subsidy, as NEV is yet to reach cost-parity to ICE. Our short term NEV sales projection is based on the expectation of the enforcement of the double credit system from 2021E, while long term sales projection is based on the government's NEV sales penetration rate target. If the government accelerates the existing subsidy reduction plan or changing the future NEV penetration outlook, it will have material impacts on product sales and earnings performance of the Company.

## Financial Summary

Income statement						Cash flow					
YE 31 Dec (RMB mn)	FY18A	FY19A	FY20E	FY21E	FY22E	YE 31 Dec (RMB mn)	FY18A	FY19A	FY20E	FY21E	FY22E
Revenue	130,055	127,739	148,901	190,449	266,797	Net income	3,556	2,119	2,642	3,939	9,235
Cost of sales	(108,725)	(106,924)	(125,980)	(161,557)	(225,021)	D&A	9,995	9,933	10,035	12,193	14,571
<b>Gross profit</b>	<b>21,330</b>	<b>20,814</b>	<b>22,921</b>	<b>28,892</b>	<b>41,776</b>	Change in working capital	(291)	3,233	1,715	6,026	2,071
Taxes and levies	(2,146)	(1,561)	(1,787)	(2,285)	(3,202)	Others	(1,319)	5,923	-	-	-
S&D exp	(4,729)	(4,346)	(5,063)	(6,666)	(9,338)	<b>Net cash from operating</b>	<b>12,523</b>	<b>14,741</b>	<b>11,419</b>	<b>10,850</b>	<b>23,213</b>
R&D exp	(3,760)	(4,141)	(4,467)	(5,523)	(7,604)	Capex & investments	(6,076)	(12,040)	(12,992)	(13,608)	(14,961)
Admin exp	(4,989)	(5,629)	(5,956)	(7,237)	(8,804)	Associated companies	(496)	(499)	(406)	(447)	(491)
Finance costs	(2,997)	(3,014)	(3,631)	(4,320)	(4,412)	Others	(7,659)	(8,342)	(3,236)	(5,009)	(6,438)
Impairment losses	(1,020)	(636)	(751)	(952)	(1,336)	<b>Net cash from investing</b>	<b>(14,231)</b>	<b>(20,881)</b>	<b>(16,634)</b>	<b>(19,064)</b>	<b>(21,890)</b>
Other income	2,328	1,724	2,143	2,907	3,837	Equity raised	-	-	-	-	-
Investment income	248	(809)	(521)	(286)	(267)	Change of Debts	5,076	10,535	13,113	15,583	10,045
GL from changes in FV	(5)	10	(53)	4	(38)	Dividend paid	(557)	(164)	(209)	(311)	(730)
GL on disposal	(19)	(100)	(72)	(88)	(168)	Others	(603)	(3,761)	5,691	5,000	8,928
<b>Operating profit/(loss)</b>	<b>4,241</b>	<b>2,312</b>	<b>2,764</b>	<b>4,445</b>	<b>10,445</b>	<b>Net cash from financing</b>	<b>3,917</b>	<b>6,610</b>	<b>7,102</b>	<b>8,913</b>	<b>2,117</b>
Non-operating income	230	226	447	381	480	<b>Net change in cash</b>	<b>2,209</b>	<b>470</b>	<b>1,887</b>	<b>699</b>	<b>3,440</b>
Non-operating expense	(86)	(107)	(112)	(143)	(212)	Cash at the beginning	9,903	13,052	12,650	14,537	15,236
<b>Profit before income tax</b>	<b>4,385</b>	<b>2,431</b>	<b>3,099</b>	<b>4,683</b>	<b>10,713</b>	Others	941	(872)	0	(0)	(0)
Income tax expense	(829)	(312)	(457)	(743)	(1,479)	<b>Cash at the end</b>	<b>13,052</b>	<b>12,650</b>	<b>14,537</b>	<b>15,236</b>	<b>18,676</b>
<b>Profit for the year</b>	<b>3,556</b>	<b>2,119</b>	<b>2,642</b>	<b>3,939</b>	<b>9,235</b>	Less: pledged cash	-	-	-	-	-
Non-controlling interests	776	504	555	827	1,939						
<b>NP</b>	<b>2,780</b>	<b>1,614</b>	<b>2,087</b>	<b>3,112</b>	<b>7,296</b>						

Balance sheet						Key ratios					
YE 31 Dec (RMB mn)	FY18A	FY19A	FY20E	FY21E	FY22E	YE 31 Dec	FY18A	FY19A	FY20E	FY21E	FY22E
<b>Non-current assets</b>	<b>79,361</b>	<b>88,675</b>	<b>100,874</b>	<b>114,549</b>	<b>129,999</b>	Sales mix (%)					
Fixed asset	43,679	49,443	58,001	66,220	74,742	Automobiles	58%	50%	38%	44%	47%
Intangible assets	11,314	12,650	14,840	16,943	19,123	Handset Components	32%	42%	49%	44%	38%
Interest in joint	3,561	4,060	4,466	4,913	5,404	Rechargeable Batteries	7%	8%	8%	8%	6%
Other non-current assets	20,807	22,521	23,567	26,473	30,731	Other business	2%	0%	4%	4%	3%
<b>Current assets</b>	<b>115,211</b>	<b>106,967</b>	<b>121,942</b>	<b>147,977</b>	<b>188,083</b>	Power battery	0%	0%	0%	1%	5%
Cash	13,052	12,650	14,537	15,236	18,676	IGBT	0%	0%	0%	0%	0%
Account receivable	49,284	43,934	49,634	61,435	76,228	Total	100%	100%	100%	100%	100%
Inventory	26,330	25,572	30,578	38,466	50,005	<b>P&amp;L ratios (%)</b>					
Other current assets	26,545	24,811	27,194	32,840	43,175	Gross profit margin	16%	16%	15%	15%	16%
<b>Current liabilities</b>	<b>116,569</b>	<b>108,029</b>	<b>128,894</b>	<b>162,465</b>	<b>205,001</b>	Pre-tax margin	3%	2%	2%	2%	4%
Borrowings	37,789	40,332	49,851	64,110	72,052	Net margin	3%	2%	2%	2%	3%
Account payables	46,283	36,168	41,993	52,115	70,319	Effective tax rate	19%	13%	15%	16%	14%
Other payables	13,568	11,217	13,228	16,964	23,627	<b>Balance sheet ratios</b>					
Tax payables	18,930	20,311	23,822	29,276	39,003	Current ratio (x)	0.99	0.99	0.95	0.91	0.92
<b>Non-current liabilities</b>	<b>17,308</b>	<b>25,011</b>	<b>29,346</b>	<b>31,751</b>	<b>35,861</b>	Quick ratio (x)	0.59	0.59	0.55	0.52	0.50
Borrowings	13,924	21,916	25,511	26,834	28,937	Cash ratio (x)	0.11	0.12	0.11	0.09	0.09
Provisions	66	103	37	59	118	Debtors turnover days	138	126	122	118	104
Deferred income tax	-	-	-	-	-	Total debt / total equity	221%	213%	245%	284%	312%
Others	3,317	2,992	3,798	4,858	6,805	Net debt / equity ratio	64%	79%	89%	84%	83%
<b>Total equity</b>	<b>60,694</b>	<b>62,601</b>	<b>64,576</b>	<b>68,310</b>	<b>77,220</b>	<b>Returns (%)</b>					
<b>Minority Interest</b>	<b>5,496</b>	<b>5,839</b>	<b>5,737</b>	<b>6,209</b>	<b>6,939</b>	ROE	5%	3%	4%	5%	11%
<b>Shareholders' equity</b>	<b>55,198</b>	<b>56,762</b>	<b>58,839</b>	<b>62,101</b>	<b>70,281</b>	ROA	4%	3%	3%	4%	5%
						BVPS (RMB)	20.23	20.81	21.57	22.76	25.76

Source: Company data, CMBIS estimates

Note: \*All numbers are based on A share financial statement

## Appendix

### ■ Company background

BYD was established in 1995. At then, its main business was chargeable batteries for cell phones. In 2003, BYD acquired Xi'an Qinchuan Automobile Co., Ltd. and officially entered into the auto OEMs area. Its first vehicle model, F3, was launched in 2005 and the first EV, F3e, was successfully developed in 2006. In 2008, the Company received an equity investment from Berkshire Hathaway (BRK US) owned by Warren Buffett. Its Cloud Rail business was successfully announced in 2016. At present, the Company has formed a complete industrial cluster with NEV business as its core business.

**Figure 118: Milestone**

Year	Milestone
1995	Company founded
2002	Listed in Hong Kong
2003	Aquire Xi'an Qinchuan Automobile Co., Ltd. and enter auto manufacturing business
2005	F3 model rolled out
2006	The first EV - F3e model equipped with LTP battery was successfully developed
2008	Berkshire Hathaway announced that it has invested US\$230 mn in BYD, accounting for 10% of the shares
2008	Hybrid vehicle - F3DM - equipped with the first generation DM technology was launched.
2009	Acquired Hunan Midea Coach Manufacturing Co., Ltd., and enter electric coach business
2010	Divison of sales channel led to retail disruption/ Enter the photovoltaic field
2011	Listed in A share
2013	Qin, equipped with the second generation DM technology, was launched
2016	Cloud Rail was launched
2018	Tang, equipped with the third generation DM technology, was launched.

Source: Company data, CMBIS

### ■ Organization Structure

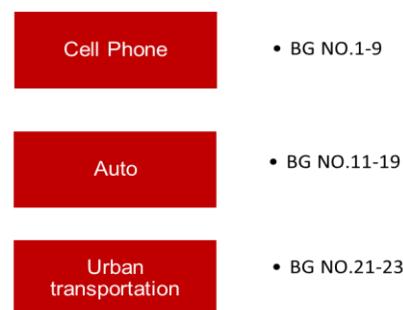
Currently, BYD has a variety of business divisions. The 1st - 9th Business Group (BG) were responsible for the cell phone business; the 11th - 19th BG were responsible for the automotive business; the 21st – 23rd BG were responsible for the urban transportation business. Recently, BYD has spun off its power battery business, IGBT business, NEV motor business, etc. into five individual companies known as FinDreams (弗迪系).

**Figure 119: Shareholder structure**

Shareholder Structure	
Wang Chuanfu	18.83%
Lu xiangyang	8.77%
Berkshire Hathaway Energy	8.25%
Rongjie Investment Holdings	5.96%
Xia Zuoquan	3.72%

Source: Company data, CMBIS

**Figure 120: Organization structure**



Source: Company data, CMBIS

## ■ Glossary

Figure 121: Glossary table

Abbreviation	English	In Chinese
NEV/EV	New Energy Vehicle/Energy Vehicle	新能源汽车
ICE	Internal Combustion Engine	传统内燃机汽车
ICV	Intelligent Connected Vehicle	智能网联汽车
NEPV	New Energy Passenger Vehicle	新能源乘用车
NECV	New Energy Commercial Vehicle	新能源商用车
Double credit policy	CAFC and NEV credit policy	双积分政策
BEV	Battery electronic vehicle	纯电动新能源车/纯电动路线
PHEV	Plug-in hybrid vehicle	插电式混动新能源车/插混路线
FCV	Fuel cell vehicle	氢燃料电池/氢燃料路线
Power battery		动力电池
LFP	Lithium iron phosphate battery	磷酸铁锂电池
NCM	Nickel cobalt manganese battery	镍钴锰三元锂电池
NCA	Nickel cobalt lithium	镍钴铝三元锂电池
BMS	Battery management system	电池管理系统
IGBT	Insulated Gate Bipolar Transistor	绝缘栅双极型晶体管
Cloud rail		云轨
FinDreams		弗迪系

Source: CMBIS

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